NUTS & VOLTS
MAGAZINE

OUR 19th YEAR

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VOL. 19 NO. 4
APRIL 1998

Exploring Electronics And Technology For The Hobbyist And Professional

Virtual Reality Illusions

Some Resources For The Hobbyist

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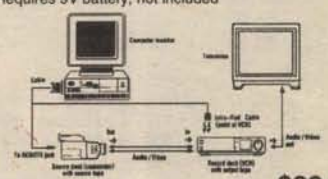

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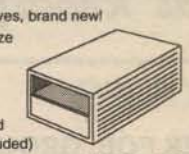

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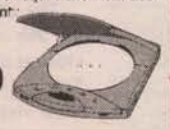

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reader FeedBack

Dear Nuts & Volts:

Regarding the Jan. '98 article on the mailbox indicator, Alltronics has a signal mail unit which works great once you get the bugs out. They sell it for $14.95, with "no returns" which should be your tip-off.

I had to replace the "tune chip" with a piezo buzzer the first use, and the latch-up didn't work until I changed a 4001 chip. But it gives both an audible, as well as a visual LED signal, and has a reset button to reset it each time. I have a distance of over 150 feet from the transmitter in the mail box to the receiver inside the house.

Bob Jordan
via Internet

Dear Nuts & Volts:

Just wanted to say how much I enjoyed the article by John Montalbano in your November issue.

I built two of the interfaces and members in our scanner club also built them. Mine was installed in a 1000 channel scanner and works very well.

The other guys in the club have been looking for something like this for a while.

I do hope to see more articles of this type dealing with the scanner hobby. Keep up the good work.

Steve Hancock
via Internet

Dear Nuts & Volts:

The circuit description of the FM Transmitter by Fred Blechman is not entirely correct.

1. He says that "with the switch SW1 in the position shown ..." the current will flow through SW1. This is a moot point, but the current will probably tend to flow through the wire shunting the switch since the wire will most likely have less resistance than the switch contacts.

2. He says that "The positive voltage at the anode of D1 powers the rest of the circuitry." I don't think so. It is the voltage across the LED which powers the circuit. One could also say the voltage at the CATHODE of D1 (with respect to the anode of D4) powers the circuit.

3. He says "If, for whatever reason, the voltage at IN1 is NEGATIVE (with respect to IN2), the LED will not light." Actually, the LED will still light and the circuit should function normally. That is the beauty of using a bridge in such a circuit; the input polarity makes no difference.

4. Assuming the "OTHER" position of the switch is the position opposite to that shown in the schematic, putting the switch in that position has nothing to do with whether diodes D2 and D3 are activated. It is the input polarity which decides which pair of the four diodes D1-D4 are conducting. From the schematic, it appears that the OTHER position will disable the circuit altogether by shorting out the bridge.

Thanks for a great magazine. I spend hours reading each issue as soon as it arrives and frequently refer to past issues for ideas.

John Smith
Plano, TX

Response:

1. He's right, but it doesn't matter. As a matter of fact, the switch, as we'll see, should not even be in the circuit!

2. He's merely more precise than my statement. The circuit will work without the LED, which is merely there to indicate the phone is off-hook and the unit is transmitting.

3. During the preparation of this article, the circuit board and schematic changed from the original. Switch SW1 was originally used to correct for reversed polarity at the phone line when only two input diodes were used. Now that a diode bridge is used at the input, this is no longer necessary.

4. The fact is, when the switch is placed in the position NOT shown on the schematic, it does, indeed, short out the phone line! Don't use the switch at all! Just leave it out of the circuit.

My thanks to John Smith for bringing this to my attention. Despite my errors in circuit description, the unit does work as described.

Fred Blechman
West Hills, CA

John Smith's Reply:

Did he actually confirm this? Note that the LED will act as a low voltage zener diode and maintain about 1.5 volts across his circuit independent of line variations. If the LED is removed, the voltage across the circuit is unpredictably set by the current through Q1 and by the line impedance.

In addition, I would expect large changes in frequency as a result of circuit voltage variations. It might be difficult to tune and keep on a particular frequency.

As for the rest, I believe the Nuts & Volts audience includes beginners, as well as seasoned electronics engineers. A beginner is depending on an accurate circuit description of operation to learn from the article whether or not he actually builds the circuit.

I sincerely do not intend to discourage Mr. Blechman. I admire his writing ability, as well as his technical capabilities and I commend him for submitting interesting articles.

John Smith
Plano, TX

Response:

John, you may have a good point regarding the use of the LED as a voltage stabilizer. I did not remove the LED to test the effect,

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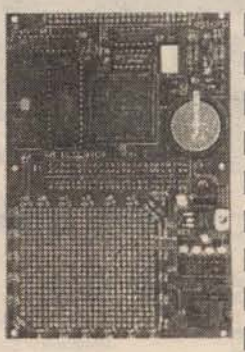

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by Gordon West

COPPER FOIL GROUNDING FOR RADIO FREQUENCIES


Copper foil for radio grounds.

Hey, all you radio guys and girls, GOT GROUND? For a powerful marine and ham single-sideband transmission, and improved reception, good grounding techniques at the radio and at the automatic antenna tuner are extremely important. And for mariners planning on installing a differential GPS receiver for improved GPS positioning, GOOD GROUND is extremely important to improve the capabilities of your low-frequency DGPS system that feeds correction signals to your onboard GPS.

GOOD GROUNDING is also important to reduce the noise build-up interaction between various pieces of marine electronics aboard a boat. You may find that the inverter turned on that wipes out TV reception might be rendered almost noise-free by grounding the metal frame to a central ground plane aboard the boat. Same thing with automatic pilots and many voltage/amperage monitoring systems — their built-in central processing units (CPUs) can generate tremendous radio frequency interference from their squarewaves, and this interference can be contained within the device by good grounding techniques.

THE ULTIMATE GROUND

You are floating on it: sea water — the ultimate ground. The conductivity of salt water is the closest thing we can get to a traditional copper-screen land ground. Did you ever wonder why big military and commercial AM radio stations always plant the base of their antennas in marshes or at the edge of ocean bays? This is because the necessary ground is already in place to make up the essential "missing quarter" of their antenna system.

The brand new Yaesu ham radio FT-847 works better with a foil ground.

THE MISSING GROUND?

Halfwave antenna principles are based on a one-quarter wavelength antenna radiator, and a one-quarter wavelength OR GREATER mirror image of the radiator. This mirror image ground system is sometimes called a COUNTERPOISE. Without a good COUNTERPOISE, a one-quarter wavelength antenna cannot develop the antenna current to force your signal off of the wire and out to the ionosphere.

Low-frequency, medium-frequency, and high-frequency antenna systems all rely on sea water as making up the other half of the radiating antenna system. Electrically, your insulated backstay or big white fiberglass high-frequency whip is tuner resonated to be one-quarter electrical wavelength long. The tuner then looks for the ground connection to develop the COUNTERPOISE as the other mirror-image one-quarter wavelength. The greater the ground counterpoise potential, the higher the antenna radio frequency current that may be developed at the output of the automatic antenna tuner.

"The effect of a perfectly conducting ground can be simulated under the antenna by installing a metal screen or mesh, such as chicken wire or hardware cloth, near or on the surface of soil ground," comments the American Radio Relay League in their *Ham Radio Antenna Book*.

"The screen should extend at least a half wavelength in every direction from the antenna ... the screen will reduce losses in the ground near the antenna ..." As you decrease these ground losses, you increase radiation resistance and the amount of current that leaps off your insulated backstay or big non-resonant whip, and takes that first long-range bounce off the ionosphere.

Luckily for us mariners, we don't need screen. Salt water is a wonderful conductor; and when you're sitting in the middle of it, you certainly exceed the half wavelength necessary for strong antenna currents in the backstay or whip.

GETTING THERE IS THE BIG JOB

So how do you ground your marine and ham single-sideband transceiver to this water ground? And how do you ground the antenna coupler to the sea water ground? One big heavy ground cable should do the trick, right?

Wrong!

Despite the fact you grounded your radio and antenna coupler with massive four-gauge, stranded conductor, your brand new marine and ham single-sideband installation just isn't working right. Other mariners tell you your signal is garbled. The high seas marine operator indicates a very weak reception of your transmission, and on voice peaks your equipment goes into oscillation. Other boaters with SSB aboard all around you can talk regularly to the gang in Hawaii; and while you can hear them relatively well, they don't even know you are trying to transmit. Yet you have these huge four-gauge wires going from your antenna and tuner down to the world's biggest ground plate that's making sea water contact with a gold-plated connection.

What's worse, every time you transmit, all your bilge pumps click on, your autopilot goes whacko, your wind and speed equipment reads gale force conditions, and the propane stove automatic lighters begin to click with every syllable. And one of your guests indicates they will never use the head again when you're speaking over your marine SSB radio. Something about being in contact with the sea water and a burning sensation.

WHY WIRES WON'T WORK

You might have thought a big four-gauge wire off of your radio and tuner would be a great way to ground your long-range radio set-up to that massive underwater ground plate. You take out your fluke ohmmeter, and the combined run of 40 feet of #4-gauge wire registers only a fraction of a DC ohm resistance. With a maximum of two amperes of RF current from an antenna system from a 100-watt SSB transceiver, we definitely don't have a DC resis-

tance problem, here, do we?

We don't, but we do.

Chances are you spotted the green #8 stranded wire that may be part of your BONDING system for corrosion control. This WIRE is more than adequate to handle the few hundred miliamps that might be flowing from a sacrificial zinc anode to the protected underwater metals. This WIRE might also provide a low resistance path to bleed off a static discharge as you're sailing through the water, or getting close to thunderstorm activity.

Wires do an interesting thing at radio frequencies, including the unpredictable alternating currents of lightning.

That big #4 ground wire you installed as part of your ship radio station ground system is making up a minimum of half of your halfwave automatically tuned Marconi antenna system. Current not only flows in the part of the antenna you never want to touch on transmit, but there may also be current that gets mighty warm as part of your wire ground system. This is because the current flowing along your wire conductor in your ground system is a moving electromagnetic field. That big ground wire that may go directly from your tuner down to the underwater ground plate may develop the characteristics of a COIL of wire — after all, that wire is in the form of a cylinder, if you think about it.

Coils at different radio frequencies develop a very special type of RESISTANCE where the phase angle of voltage and current within the electromagnetic field TRAP the RF currents from making it from the automatic tuner all the way down to that big copper ground plate. It's not the slight resistance of the big wire that TRAPS the energy, but rather the fact that wire is round, and behaves like a radio coil at certain frequencies. And because you're using many different frequencies on ham and marine, and because your automatic antenna tuner develops its own internal inductive and capacitive reactance to develop resonance in the antenna circuit, there is no telling what length of wire, what frequency, or what wavelength won't see the nearby water as the great ground potential that it is.

Sure, you could move your tuner and put it right down there next to the big ground plate, and this would solve the problem nicely. But now you have the added problem of RF being transmitted from the water line up, off of that single GTO-15 high voltage wire, getting into all of the other electronics onboard. Better leave the automatic antenna tuner right where it is, in the lazarette or hanging locker aft in a sailboat, or up near the antenna in the flying bridge of a power boat. Or in a home installation, the automatic antenna tuner is up at roof level, keeping all of the radio frequency energy safely away from the operator down below.

Copper foil offers negligible reactance at maritime and ham radio medium-frequency and high-frequency wavelengths. Copper foil takes your sea water ground and brings it right up to the base of the tuner with almost no DC I2R losses, and virtually no trapping of the signal caused by wire reactance.

Copper foil from the tuner to a good sea water ground eliminates the need for one-quarter wavelength radials run below decks, and may also eliminate the need for that 100 square feet of ground which was what we originally had to do in the old days where antenna tuning was done at the radio, rather than automatically in the automatic antenna coupler.

"The outside one square foot ground plate will develop a terrific sea water ground potential if coupled to the automatic coupler using three-inch-wide copper foil," comments Jim Tindall of ICOM America. "But I always suggest that the more ground potential you can add to your marine and ham SSB system, the better," adds Tindall, indicating he might also ground to additional bonded underwater bronze through-hulls for additional sea water contact. It certainly wouldn't hurt.

In fact, the underwater bronze through-hulls that are part of your underwater bonding system make for great sea water pick-up points for your copper foil. Wire brush each bronze through-hull, wrap the foil around it and secure it with a stainless steel hose clamp, and then run the foil to other nearby bonded underwater bronze through-hulls. Since they are already bonded together with the corrosion control green wire, you are not changing your underwater galvanic balance.

During recent tests with three-inch-wide copper foil, I found that three or more bonded underwater bronze through-hulls gives me about the same performance as a dedicated underwater ground plate. Why bore a hole in the bottom of your boat for a ground plate if you don't have to? Got some bonded bronze through-hulls? Give them a try, first.

Shortwave reception improves with a foil ground.

If you are swapping out wire for copper foil, get the wire out of circuit. Use the wire for something else — maybe re-doing that corrosion control bonding system to meet American Boat & Yacht Council (ABYC) recommendations. ALWAYS adhere to ABYC recommendations.

For power boats, your job is getting from the automatic tuner in the flying bridge down below to those underwater through-hulls. It's perfectly acceptable to squash the foil into an irregular slim mass, now and then, to squeeze through tight areas. Just try to keep as much surface area exposed on the foil as possible.

For home installations, your job is to get the copper foil over to the chicken wire that holds the plaster on the side of your home. Or maybe run the foil down through a rain water downspout, and start burying it in the soil.

For home installations, keep in mind that soil is a lousy ground, and doesn't have near the conductivity as sea water. You must run over 100 feet of three-inch-wide copper foil buried under the ground to achieve good soil contact. You may notice your signal will get better after a big rainstorm, too!

See, mariners, what a good deal we have by running our station floating in the world's best ground plane?

Marine radio manufacturers ICOM America and Shakespeare Antenna both commissioned one-hour-long individual audio cassettes ALL ABOUT MARINE SSB INSTALLATIONS, and ALL ABOUT MARINE VHF RADIO AND INSTALLATIONS. You can get these two audio cassettes directly from me for a $20.00 bill by writing Radio School, 2414 College Drive, Costa Mesa, CA 92626. You can actually hear the difference between wire grounding and foil grounding systems.

The biggest provider of radio ground foil in bulk lengths of your choice is Metal & Cable Corporation, Twinsburg, OH; phone 330-425-8455, FAX 330-963-7246, or E-Mail David@metalcable.com. Besides their .0073-inch-thick x three-inch-wide pure copper foil, they also carry heavier .011-inch-thick x two-inch-wide copper strap with machine edges for safer handling. This is what I use for my home high-frequency radio installation where I don't need to fold it to sneak around tight corners as I would aboard a boat. This heavier strap is also a better way to convey nearby lightning surges directly to a good ground. I use this heavier copper foil off of my coaxial cable lead-in point on the side of my house directly down to a massive wet-soil ground system.

Aboard sailboats, I have seen this heavier foil added to the existing lightning wire ground system going from the base of the mast directly down to a keel bolt or underwater ground plate.

But if you should encounter a direct lightning strike, don't expect much of anything to work after the bolt other than your little handheld radio to call out for help. Lightning is unpredictable, and is a completely different subject than the need for a good radio frequency ground.

Finally, I suggest you also ground your stainless steel rails aft with the three-inch-wide copper foil. This will allow you a good sea water ground point for that new differential beacon receiver you're going to put back there for the reception of low-frequency RDF-type GPS correction signals broadcast by the United States Coast Guard. Soon the US Coast Guard will have access to hundreds of land transmitting stations originally intended for the emergency broadcast service. Copper foil grounding techniques will allow you to pull in differential GPS correction signals all over the country — inland or out on the water. Since these signals are down below the AM broadcast band (200 KHz-500 KHz), good copper foil grounding techniques will dramatically improve your receiving capabilities.

Also ground all of your other instruments aboard the boat — this will decrease the amount of noise coming out of those CPUs. For instruments, you can fold the three-inch foil in half, and this will suffice.

Got enough ground? That's easy to tell. Take that extra foil you ended up with, and toss one end into the sea water. Get someone to hold it near the antenna coupler. Make contact with a ham or marine shore station, and get an initial signal report. Now have your assistant touch the foil to the existing ground system, and see if your signal changes with this additional hunk of foil hanging in the sea water.

If the automatic tuner doesn't re-tune, and if the radio service says you sound the same, then you know that additional grounding is not necessary. See, I told you that just one or two good ground connections from your automatic coupler is all that is necessary if you use copper foil.

Copper foil — low reactance, good results. NV

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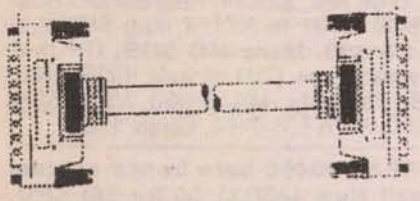

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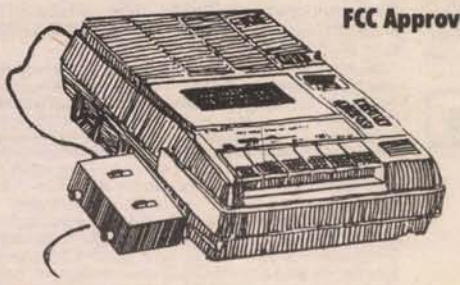

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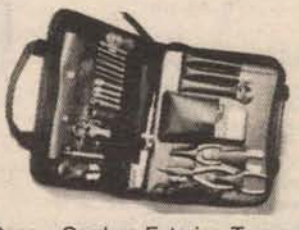

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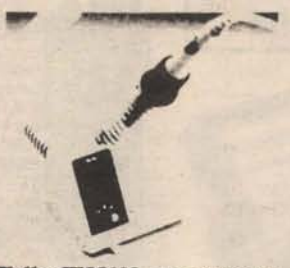

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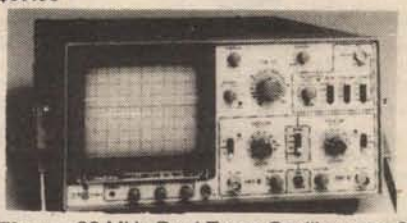

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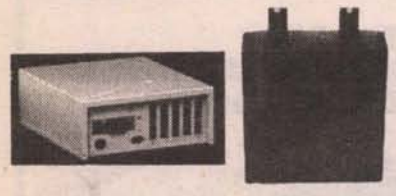

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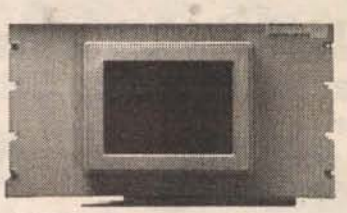

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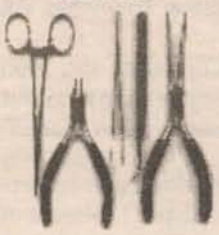

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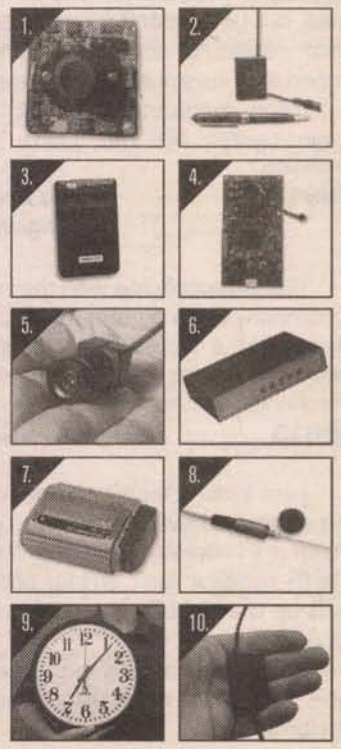

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Questions & Answers
TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts readers* and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and *NO GUARANTEES WHATSOEVER* are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 91719, OR fax to (909) 371-3052, OR E-Mail to **forum@nutsvolts.com**

I have a Toshiba T4400SX laptop computer that has no video information, but the LCD display does light up. It works fine with another monitor.

The LCD has been replaced, but can someone identify the component that needs to be replaced without buying a board.

4981 **Lee Amanns**
Cincinnati, OH

I have a full hard disk backup which I cannot retrieve. It was backed up with Windows 95 back-up utility.

I was using Lantastic for DOS which caused Windows 95 to crash (the registry files were crosslinked).

I have since removed the offending software and re-installed Windows. However, I still can't access the back-up file. It is a 468 megabyte ".QIC" file on the hard drive.

The back-up uitility says it is unable to retrieve anything from this file. I ran scandisk and it reported no errors. The only files lost were photos of our company's annual banquet, so I was told not to spend much time (and no $) trying to retrieve them.

4982 **David Eaton**
via Internet

What are the pinout, impedance, and levels for an "S-VHS" connector?

I need to build a splitter, but haven't been able to find S-VHS specs.

4983 **David Schoepf**
Marianna, FL

I own a Radio Shack (Cat. #22-168) digital multimeter with a PC interface, I would like to buy a second if there existed a program/interface for plotting both the dependent and independent variable of choice. This could be time-based as present and plotted on the computer to be printed example speed of propeller vs. output voltage of a wind-generator, sunlight vs. water temperature (thermistor resistor, etc.).

4984 **William Cherry**
Beltsville, MD

I keep hearing the terms pull-up and pull-down resistors in conjunction with the I/O of the Parallax Stamp.

Could someone explain (in laymen's terms and diagrams) what these are, when and how they're used, and how their values are calculated?

4985 **T. L. Curran**
Danbury, CT

I would like to know how to get a VCR Plus+ working again. The main screen died and the numbers are very faint. I put in new batteries.

The company Gemstar won't repair it and I can't purchase a new one. They stopped making them, except with built-in encoders in VCRs.

4986 **Hank Kurtz**
Pittston Township, PA

I have a DTK Computer, Inc. 286 IBM clone. It has an open 40-pin socket for a math coprocessor. I got a 80287-XL coprocessor for it, but without any programming. What do I have to program to use this chip? I have not installed it as yet.

4987 **Joseph W. Baldwin**
Warren, MI

I need a circuit that will take an RF signal in the range of 4 MHz to 40 MHz with a level of about 0.8 volts and turn it into a clean 0 to 5 volt CMOS logic compatible squarewave.

A 50-50 duty cycle is highly desirable.

To keep loading of the RF source low, the circuit should have a high-input impedance and will need to be capacitor coupled. Basically, this is the input section of a frequency counter.

4988 **Richard W. Floe**
Kearney, NE

I have an amp that needs a schematic so it can be repaired. Does someone have a schematic to an Alpha Remote Mate amp? Or, where can I have it repaired?

4989 **Grayle C. Hunley**
Mechanicsville, VA

I just read your Jan. '98 issue. I need some help obtaining the circuit diagram or at least the pinout of the eight-pin plug for an RCA camera Model #TC 1110-4.

49810 **John Erskine**
Los Angeles, CA

I have a communications shortwave receiver that needs to be realigned. The radio is an old tube type.

Alignment of the IF stages are no problem. On the other hand, the RF/local oscillator coils have the tuning slugs sealed in place with a white substance. I thought it was paint. However, applying a small drop of paint remover did not soften the substance. Coils are wound on 1/4" forms.

Any ideas how I can free the tuning slugs?

49811 **James Brendage**
Orangevale, CA

I recently completed construction of an LM1877 stereo amplifier as described by Ray Marston in his series on "Audio Power Amplifiers." Sounds great. I needed a stereo amplifier for my 31-inch TV set.

However, there is a problem with TV radiation introducing noise into the speakers. The closest speaker is four feet away.

Will a shield using aluminum foil fastened inside the speaker enclosure eliminate this inteference?

There was some TV buzzing noise coming through the shielded input lines, but I eliminated it by placing 600-ohm resistors across the lines. An impedance mismatch, but it worked.

Your magazine is great for an experimenter like me. Don't change anything.

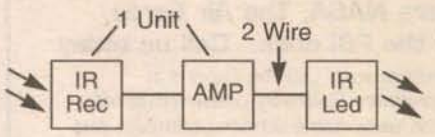
49812 **James Brendage**
Orangevale, CA

Please supply me with the name of a company or an amateur who can supply me with a 12-volt remote controlled switch similar to the security door lock mechanism for a car door.

49813 **G. Lewis**

I am looking for a schematic for an IR repeater. I have tried various ways to make a IR repeater, but the output of the IR receiver isn't strong enough to light up the IR LED. The output voltage is too low.

The IR repeater is of the hardwire type. Below is a block diagram of what I'm looking for.



I have tried to use an op amp to boost the output signal so it will operate the IR LED. Still to no success.

49814 **Ray Samples**
Fayetteville, NC

I have a soundblaster sound card. The card came with a program called SB Talker that gave the computer programmed speech. How can I get programmed speech from my own programs written in GW-BASIC?

49815 **M. Martin**
Elmira, NY

I am a do-it-yourself audio nut, and I build my own crossovers, using air core inductors. But finding exactly the right value for an inductor can be difficult. I am wondering is there software available that will tell me how much wire to put on a core, if I give it core dimensions, wire size, required inductance,

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of $25.00 will be sent if your answer is printed.
- In most cases, only one answer per question will be printed.
- Your name, city, state, and E-Mail address, (if submitted by E-Mail), will be printed in the magazine, unless you notify us otherwise with your submission.
- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:
1) Circuit Design 3) Problem Solving
2) Electronic Theory 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS

- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

etc., or any of the above in combination?

I have been looking all over the Internet, and have not been able to come up with anything.

49816 **David Draper**
via Internet

I need to add more memory to a TI-85. I think there is a box to do that, hooked to the link cables. I heard about it on the Internet. Also how do I take off edit lock on programs for the TI-85, also anything on hacking the TI-85 would help.

49817 **Kyle Nonneman**
Madison, WI

I have a BSR model EQ-3000 equalizer with a power supply problem. The address for BSR products in Newton, MA is out of date. I would like a current address and/or phone number for BSR products.

49818 **Elmer Schmall**
Tulsa, OK

I'm using a LM1458 op-amp and need the output to switch a TTL gate. The only problem is that the 'low' output from the op-amp is about 1.9 volts. It needs to be below .8V to interface with TTL logic.

Is there a simple way to drop the voltage down to an acceptable level?

49819 **Kyle Gilpin**
via Internet

I understand that my Motorola Star Tac cellular has the vibrating device inserted in the phone, but I would like to know hot to activate this option on the Star Tac Cell-Phone

49820 **via Internet**

I have a robot platform-based on the Rug Warrior (*Mobile Robots: Inspiration to Implementation*, Jones/Flynn), which has a problem with reverse direction and velocity control of the right motor.

The motor can be controlled for forward direction and velocity, but stops when commanded for reverse direction.

I suspect it's a software problem, but I'm stymied by the bit-level control of memory for motor operation.

The robot is programmed using the MIT freeware, Interactive C. The robot was not assembled from a kit, so help is scarce.

The Interactive C manual cites a "Rug Warrior Experts Group" for further assistance? If anyone has encountered and resolved the same problem, help would be appreciated.

49821 **David Wing**
Salem, NH

I have purchased five of Weeder's tech's kits. I feel somewhat limited using QBASIC as the program of choice. I have decided to change to Turbo C++.

I am still learning this new programming code. Can you tell me of any programs that you know of that run this code for the Weeder pro kit?

49822 **J. F. Wagner**
via Internet

ANSWERS

ANSWER TO #39811 - MAR. 1998

There are many claims on the market for rejuvenating Ni-Cad batteries and most of them either don't work, or simply contain $1.00 worth of components.

One of the common failures with Ni-Cad batteries besides loosing their precious gas (hydrogen) is sometimes referred to as "whiskers." This is caused by a growth inside the battery which shorts out the cells partially or wholly, and lowers the capacity of the batteries output. Although this is not the only problem related to Ni-Cads, it is a common one.

A simple 100 to 500 uF capacitor charged up to around 100+ (150 max) volts DC, shunted into each individual cell one at a time through a toggle switch, disintegrates the whiskers by melting them while leaving the battery unaffected due to the short duration of the pulse.

You apply the power through a two pole, dual throw switch as a safety precaution against accidently applying the full wall power directly into the cell.

I usually get a 50 to 75 percent return on very old surplus batteries that don't show signs of leakage or corrosion on their seal. (Positive lead) batteries that show signs of leakage rarely last more than a few months no matter what you do.

Chris
Bieber, CA

ANSWER TO #39810 - MAR. 1998

For your pocket alarm, I suggest a PIC controller, serial clock chip, and an alpha-numeric LCD display. Using a segment-type display creates a serious interconnect problem likely to require a large FPGA chip to handle. The more complex display should actually lower your system cost.

The PIC controller is available from Microchip. Versions programmable in BASIC are the BASIC Stamp (Parallax) and the FBASIC Ticket (VersaTech).

I recently have designed a system that includes all of your functions using the VersaTech device and I am willing to discuss my experience.

Mike Beaver
Los Altos, CA

ANSWER TO #3987 - MAR. 1998

RJ-11 and RJ-45 telephone connectors are wired such that the first pair is in the center of the connector and the following pairs work outward.

If you hold a plug with the locking tab down and the cable pointing away from you, pin 1 is on the right. For RJ-11 (six pins) R1 (ring) is pin 3, T1 is pin 4, R2 is pin 5, and T2 is pin 2. For RJ-45, the sequence is R4, T3, T2, R1, T1, R2, R3, T4.

Mike Beaver
Los Altos, CA

ANSWER TO #3983 - MAR. 1998

Your solar system controller sounds like a job for an LM324 quad op-amp.

Use a five-volt supply and thermistors for the temperature sensors.

Continued on page 106

ANSWERS TO #29813 - FEB. 1998

A company called Tech America in Ft. Worth, TX, has an inductance meter kit ($14.95) to be used with a DMM. Its part number is 990-0057. Tech America can be reached at 1-800-877-0072, and there is no minimum order.

Matt Brzescinski
Poway, CA

ANSWERS TO #29813 - FEB. 1998

Here are two catalog services for inexpensive inductance measuring kits that can be used with a digital multimeter:

1. Marlin P. Jones & Assoc., Inc., has a digital inductance meter kit stock #4519-RB that will measure inductors from 3 µH to 7 mH. Their address is: P.O. Box 12685, Lake Park, FL 33403-0685 and phone 1-800-652-6733.

2. Gateway Electronics, Inc. has a capacitance/inductance meter kit that measures inductors from 10 µH to 10 mH and capacitors from 2 pF to 2 µF. Their address is: 8123 Page Blvd., St. Louis, MO 63130 and phone 1-800-669-5810.

John McMichael
Laramie, WY

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WANTED: TERMINALS + PRINTERS: DEC, Wyse, IBM, ADDS, Okidata, Data South, Epson, C.ITOH, etc. Call for quote on any surplus computer equipment. Call Jeremy, 603-673-8077.

WANTED: 286/386/486 old computers, cards and parts, NEC, PB, Dell, AT&T, Compaq, etc., BNFE, F978-536-7400. WWW.BNFE.COM E-Mail.

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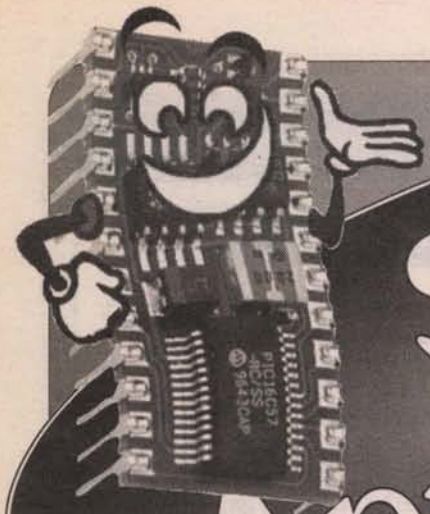


Stamp Applications:

Putting the Spotlight on BASIC Stamp Projects, Hints, and Tips

by Jon Williams

Having used it since the spring of 1994, I still turn to the BS1 as my default Stamp. Yes, the BS2 has more code space, more I/O pins, and extended features in PBASIC. I find, however, that the BS1 is suitable for most of my personal projects. It's only when I know I'll need the extra pins or code features that I use the BS2.

Getting Back To The BS1

Back in 1994, when there was no BS2 to turn to, BASIC Stamp had to resort to clever coding and I/O schemes to make projects work. The introduction of serial peripherals like Scott Edwards' Serial LCD Backpack® and Stamp Stretcher pulled a lot of us out of jams. This month, we're going to discuss some hardware and software techniques that just might help you out of a jam and squeeze your project back into the BS1.

Sharing Pins

From time to time, we'll run out of pins before we run out of code space. This is especially true with the BS1. With careful (read that again, I said, "careful") code writing and I/O hardware, we can share one or more pins. The trick is modifying the Dirs variable mid-stream. We don't normally do this, so we need to be cautious.

Take a look at the circuit in Figure 1. This circuit allows us to display the status of the I/O pin when it's an output, and to read it when it's configured as an input. Notice that this circuit is configured for negative logic. What this means is that a low output will light the LED, a high output will turn it off. Don't be alarmed by this; you can easily change positive logic (HIGH = On) to negative logic with the ^ (Exclusive OR) operator (0 ^ 1 is 1).

Okay, let's use this circuit. Listing 1 is a very simple program that waits for you to push the button connected to Pin0, then flashes the LED five times. Notice that the Dirs variable is reset to configure the pin before each section. In case you're wondering, the purpose of the 470-ohm resistor is to protect the I/O pin in case you push the button when the pin is in an output condition. If you pressed the button when the Stamp had placed a HIGH (5 volts) on the pin, you'd have a short to ground. The resistor limits the current through this short to a safe level.

For another good example of pin sharing, refer to the Stamp Application Note #1, "LCD User-Interface Terminal." You can download this App Note from Parallax (see sources). By the way, the BASIC Stamp Activity Board that I mentioned last month comes with four of these LED/switch circuits.

```
' Listing 1
' Nuts & Volts: Stamp Applications, April 1998

GetPin: Dirs = %00000000        ' all pins are inputs
    IF Pin0 = 1 THEN GetPin     ' wait for pin to go low

Blink:  Dirs = %00000001        ' make pin 0 an output
    FOR B0 = 1 TO 5
      PAUSE 500
      Pin0 = 0                  ' LED on
      PAUSE 500
      Pin0 = 1                  ' LED off
    NEXT

    GOTO GetPin                 ' do everything again
```

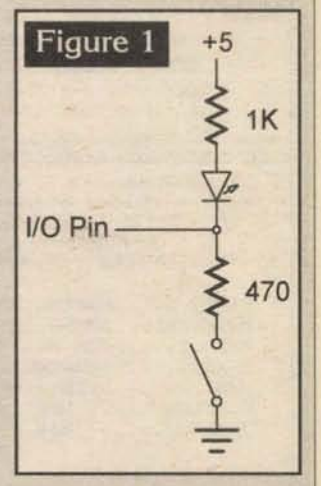
Sizing Up Your Code

Within minutes of opening my first BS1, I had it up and running code. Within hours, I was writing useful programs. Within days, I ran into the dreaded "Error – EPROM Full" message from the Stamp compiler. "Yikes! What do I do now?" What I had to do was find code-saving techniques, but the pseudo-analog bar-graph display of the BS1 compiler didn't help much with my experiments; its resolution is much too coarse.

At the time, the BSAVE command wasn't really documented, but was made known through a small App Note that came with the BSLOAD utility. BSAVE writes a 256-byte binary file that is an image of the Stamp's EEPROM for your program. The EEPROM contains your code and user data and — more importantly — an address of the last EEPROM byte used by the program code. With this knowledge, I was able to write a program called STMPSIZE.EXE (for Stamp Size). What this program does is read CODE.OBJ (the file created by BSAVE) and displays the results with a straightforward text output.

Using STMPSIZE is easy; just include the BSAVE command in your program and hit [Alt]+[R] (run). The nice thing about BSAVE is that the file is created before the compiler actually tries to download the program to the Stamp. This means that you don't need to connect your Stamp to do program analysis.

Figure 1



Let's look at a quick example. I found, through experimenting and using STMPSIZE, that I can gain a few precious bytes of code space by replac-

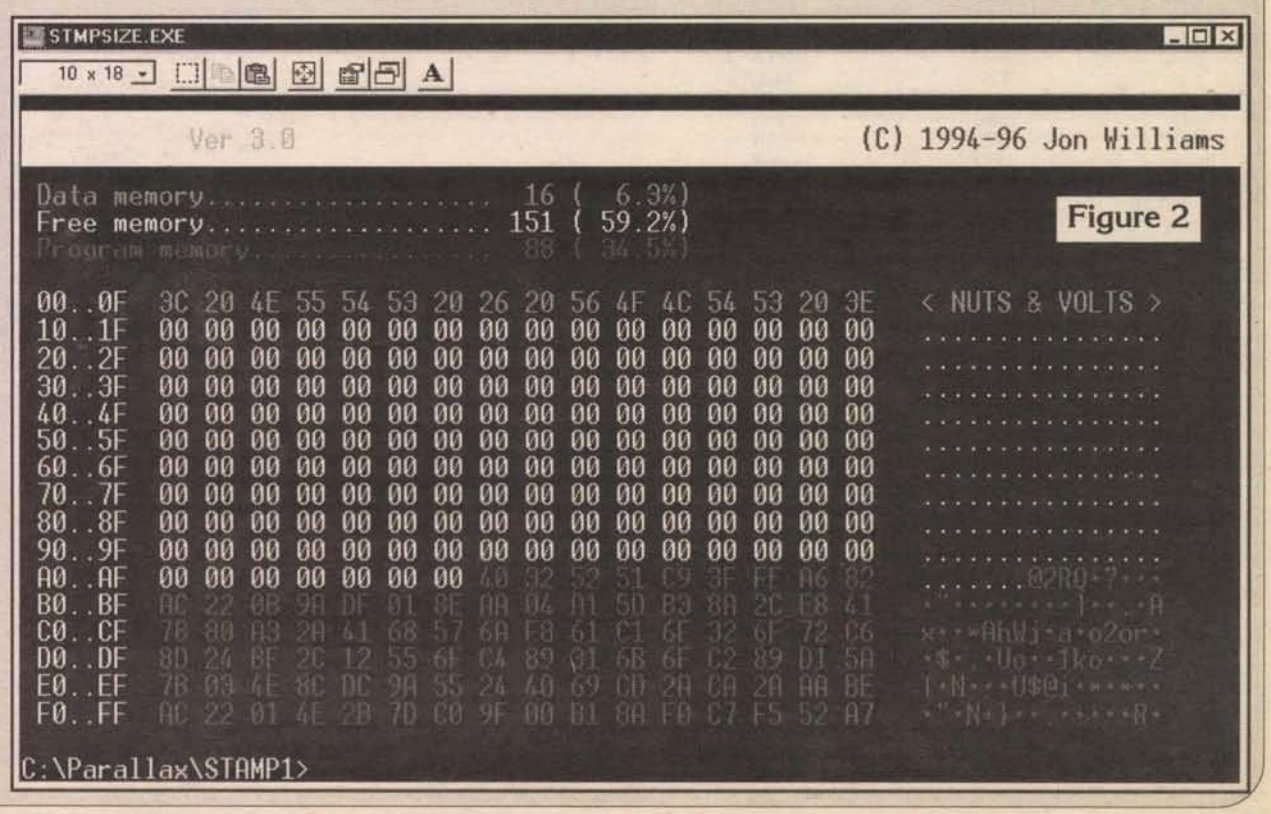


Figure 2

ing a LOOKUP table with EEPROM statements and using READ to get the data. This is particularly useful if the data is used more than once and is not part of a subroutine.

Listing 2a is a small program that sends a message to a standard (not serial) LCD. Analysis with STMPSIZE shows us that the program uses 111 bytes. Now replace the output section with the code in Listing 2b and check it again. Now we've used 104 bytes (code plus data) — a savings of seven bytes. This may not sound like much but, believe me, it is! You can find STMPSIZE.ZIP in my FTP directory (see Sources). Figure 2 shows a screenshot of STMPSIZE with the modified code.

```
' Listing 2b
' Nuts & Volts: Stamp Applications, April 1998


' Replace sections of Listing 2a with this code


' -----[ EEPROM Data ]-----------------------------
'
    EEPROM ("< NUTS & VOLTS >")


' -----[ Main Code ]-------------------------------
'
Start:  FOR index = 0 TO 15
          READ index, char
          GOSUB LCDwr
        NEXT
        END
```

No Missed Inputs

Once you get comfortable with the Stamp, you'll probably want to start connecting it to external devices and circuits. The trouble starts when your external circuit does something when you're not expecting it. Your program may well be running some process that takes longer than your input is active. There are two things we can do, and I'm going to recommend them both.

The first thing we can do is stretch a short input, thus making our input pin active long enough to come around and see it. The type of circuit we need is called a one-shot or, for you extreme technocrats, a monostable multivibrator. What we have to do is design the output to be long enough for us to finish what we're doing so that it can see the input.

There are probably as many one-shot designs as there are people on the planet, so I'm going to use the ubiquitous 555 timer chip. They're tough, easy to use, and very easy to find. Take a look at the circuit in Figure 3, which is a 555-based adjustable one-shot. A low on Pin 2 of the 555 will cause the output (555 Pin 3) to go high for a period determined by R1 and C1 (multiply R1 by C1 to find the time).

You need to be careful not to make your 555 output pulse too long, otherwise you might miss another input. If you have an extra Stamp pin, you can fix this problem by connecting an output to Pin 4 of the 555. This pin is the Reset input. When taken low, it will reset the 555 output. I used this technique in a project with great success. If you don't connect Pin 4 of the 555 to the Stamp, connect it to +5 volts.

Okay, what about software? If you analyze most of your programs, you'll probably find that they're a collection of small modules that run over and over in a continuous loop. Let's say, for example, that we want to check an input, then do three

Sources

For more information on the BASIC Stamp, contact:

Parallax, Inc.
3805 Atherton Road, #102, Rocklin, CA 95765
phone **(916) 624-8333**
Internet **http://www.parallaxinc.com**

Scott Edwards Electronics, Inc.
2700 E. Fry Blvd. Suite A4, Sierra Vista, AZ 85635
phone **520-459-4802**; fax **520-459-0623**
www.seetron.com info@seetron.com

Jon Williams
1505 Grande Blvd., #1602
Tyler, TX 75703
(903) 509-1691
jonwms@aol.com
Internet: **http://members.aol.com/jonwms**
ftp://members.aol.com/jonwms/stamps

```
' Listing 2a
' Nuts & Volts: Stamp Applications, April 1998


' -----[ Title ]-----------------------------------------------------
'
' File..... SSDEMO.BAS
' Purpose... STMPSIZE Demo
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' WWW...... http://members.aol.com/jonwms
' Started... 07 MAR 1998
' Updated... 07 MAR 1998


' -----[ Program Description ]---------------------------------------
'
' LCD Connections:
'
' LCD         (Function)          Stamp
' ---------------------           -----
' pin 1          Vss              Gnd
' pin 2          Vdd              +5
' pin 3          Vo               Gnd (or wiper of 10K pot)
' pin 4          RS               Pin 4
' pin 5          R/W              Gnd
' pin 6          E                Pin 5
' pin 7          DB0              Gnd
' pin 8          DB1              Gnd
' pin 9          DB2              Gnd
' pin 10         DB3              Gnd
' pin 11         DB4              Pin 0
' pin 12         DB5              Pin 1
' pin 13         DB6              Pin 2
' pin 14         DB7              Pin 4


' -----[ Revision History ]------------------------------------------
'


' -----[ Constants ]-------------------------------------------------
'
SYMBOL  RS       = 4                ' Register Select (1 = char)
SYMBOL  E        = 5                ' LCD enable pin  (1 = enabled)

' LCD control characters
'
SYMBOL  ClrLCD   = $01              ' clear the LCD
SYMBOL  CrsrHm   = $02              ' move cursor to home position
SYMBOL  CrsrLf   = $10              ' move cursor left
SYMBOL  CrsrRt   = $14              ' move cursor right
SYMBOL  DispLf   = $18              ' shift displayed chars left
SYMBOL  DispRt   = $1C              ' shift displayed chars right
SYMBOL  DDRam    = $80              ' Display Data RAM control


' -----[ Variables ]-------------------------------------------------
'
SYMBOL  char     = B1               ' character sent to LCD
SYMBOL  index    = B2               ' loop counter

' -----[ EEPROM Data ]-----------------------------------------------
'


' -----[ Initialization ]--------------------------------------------
'
Init:   Dirs = %00111111            ' set 0-5 as outputs
        Pins = %00000000            ' clear the pins


' Initialize the LCD (Hitachi HD44780 controller)
'
LCDini: PAUSE 500                   ' let the LCD settle
        Pins = %0011                ' 8-bit mode
        PULSOUT E, 1
        PAUSE 5
        PULSOUT E, 1
        PULSOUT E, 1
        Pins = %0010                ' 4-bit mode
        PULSOUT E, 1
        char = %00001100            ' disp on, crsr off, blink off
        GOSUB LCDcmd
        char = %00000110            ' inc crsr, no disp shift
        GOSUB LCDcmd
        char = ClrLCD
        GOSUB LCDcmd


' -----[ Main Code ]-------------------------------------------------
'
Start:  FOR index = 0 TO 15
          LOOKUP index,("< NUTS & VOLTS >"),char
          GOSUB LCDwr
        NEXT
        END

' -----[ Subroutines ]-----------------------------------------------
'
LCDcmd: LOW RS                      ' enter command mode
                                    '  then write the character

' Write ASCII char to LCD
'
LCDwr:  Pins = Pins & %11010000     ' save 7, 6 and RS; clear bus
        Pins = char / 16 | Pins     ' output high nibble
        PULSOUT E, 1                ' strobe the Enable line
        Pins = Pins & %11010000
        Pins = char & $0F | Pins    ' output low nibble
        PULSOUT E, 1
        HIGH RS                     ' return to character mode
        RETURN
```

Stamp Applications:

```
' Listing 3
' Nuts & Volts: Stamp Applications, April 1998


' -----[ Title ]-----------------------------------------------------
'
' File..... BRANCH.BAS
' Purpose... Demonstrates the use of BRANCH
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' WWW....... http://members.aol.com/jonwms
' Started... 07 MAR 98
' Updated... 07 MAR 98

' -----[ Program Description ]---------------------------------------
'
' This program demonstrates the use of BRANCH as a means of replacing
' confusing IF-THENs and GOTOs in a dynamic program

' -----[ Revision History ]------------------------------------------
'
' -----[ Constants ]-------------------------------------------------
'
' -----[ Variables ]-------------------------------------------------
'
SYMBOL  state   = B1

' -----[ EEPROM Data ]-----------------------------------------------
'

' -----[ Initialization ]--------------------------------------------
'
Init:   state = 0


' -----[ Main Code ]-------------------------------------------------
'
Main:   DEBUG "Checking the Input",CR ' check the input (sim)
                                      ' do other important things here

    BRANCH state,(ProcA, ProcB, ProcC)       ' do the next process


ProcA:  DEBUG "In Process A",CR
    PAUSE 1000                        ' simulate timing of process
    state = 1                         ' point to next process
    Goto Main

ProcB:  DEBUG "In Process B",CR
    PAUSE 1000
    state = 2
    Goto Main

ProcC:  DEBUG "In Process C",CR
    PAUSE 1000
    state = 0
    Goto Main

    END

' -----[ Subroutines ]-----------------------------------------------
'
```

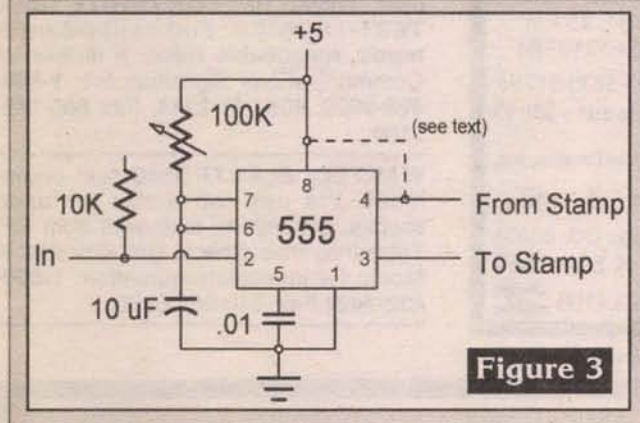


Figure 3

other things. Normally, our program flow would look something like this:

Look for the input
Do Process A
Do Process B
Do Process C
Do everything again

If we're worried about missing the input, we'll want to check it more often. Like this:

Look for the input
Do Process A
Look for the input
Do Process B
Look for the input
Do Process C
Do everything again

At first glance you might say, "Oh, that's easy, check the input in a subroutine." Sure, that's one way to do it, and it will work in most cases. There will be times, though, when you run out of GOSUBs (you overrun the GOSUB stack). We need another approach.

BRANCH is one of the most powerful — yet least-used — elements of PBASIC. What BRANCH does is direct the flow of your program based on the value of its control variable. Take a look a Listing 3. Notice that we start by checking our input (simulated with a DEBUG statement) then branch to the current process. At the conclusion of each process, the program loops back to the beginning.

Using BRANCH to control program flow is very powerful. The real power comes when you allow each process to dynamically modify the control variable. Using this technique will cause your program to become very dynamic in its operation, without a confusing mess of IF-THENs and GOTOs.

A New Serial LCD

There's been a lot of "knock-off" serial LCDs since Scott Edwards first introduced them, but none very notable until now. By the time you read this, the ILM-216 should be available from Scott Edwards Electronics. I had a chance to work with a pre-production unit and I must say that I'm thrilled. Take a look at the specifications:

Two lines of 16 characters
LED backlighting
Output for a piezo speaker
Four switch inputs
EEPROM storage of six custom characters
EEPROM storage of two-line "splash" screen

Not bad, huh? A two-line LCD and four switch inputs for the price of a single I/O pin. The ability of the ILM-216 to store custom character maps and a splash screen means that we don't have to implement those features in code. This gives us more space for the meat of our program.

The ILM-216 comes with Scott's typically excellent documentation, so I'm not going to go into a lot of detail, except to say that its serial input and serial output lines can be tied together through a 1K resistor. Since the BS1 can send and receive serial data with the same pin, this configuration is a potential project saver. I'm working on a BS1 networking project that will use the ILM-216 for the node display. Look for details in a future article. **NV**

Beginner's Corner

The LED (light emitting diode) is probably the most common status indicator used in electronic circuits. Those of us with design experience rarely think about the details of incorporating them; those without experience (or who are new), should. LEDs are not like light bulbs. That is, you can't connect them directly between an I/O pin and ground (or +5) — they need to have a current-limiting resistor placed in the series to protect the LED and the Stamp. So how do we figure the correct size for that resistor? With Ohm's Law and a pocket calculator.

Without going into a lot of engineering, here are the basics: The current in a series circuit is the same through all components, and the total circuit voltage is divided among the components. In order to operate correctly, an LED needs a certain current (called forward current) at its specified forward voltage.

Let's say we have an LED with a forward voltage of two volts with a forward current of 10 milliamps. With a five-volt output from our Stamp, our resistor needs to handle three volts at 10 milliamps. Using the Ohm's Law formula R = E/I (resistance equals volts divided by current), we end up with a calculated resistance of 300 ohms (3 / 0.01). Chances are that your corner electronics distributor (the guys who ALWAYS ask for your address) doesn't carry a 300-ohm resistor, but they do have them at 330 ohms. This will work fine. It's always safer to use a slightly larger resistor until you get the hang of circuit design.

Now, what we've just gone through only considers one pin. What if we want to light six LEDs? Will it work? Sorry, no. Well, not without problems. You see, the Stamp 1 can only source 40 milliamps of current. What this means is that the Stamp can only provide 40 mA when the outputs are high (+5). We can get a little more juice (up to 50 mA) from the Stamp by connecting the LEDs to +5 and activating them with a low output (like Figure 1). This is called sinking the current.

What we have to do is divide our available current by the number of outputs. Be careful here. Most general-purpose resistors have a 5% tolerance. This means that the resistance could be up to 5% lower than the marked value. Lower resistance means more current. You can either figure in the tolerance, or start your calculations without trying to use all the available current.

We'll be conservative and sink (active outputs are low) 40 mA of current. This gives us about 6.6 mA per LED, which means we'll need a resistor for each of 454 ohms. The closest standard value is 470 ohms, so that's what we'll use.

TEST EQUIPMENT *cont.*

WANTED: HI-voltage power supplies and hi-pot testers. Jennings JHP-70A, Von's C-1, hi-potronics, Spellman. Also looking for VDF 2.8pF Jennings capacitors and hi-voltage calibration resistors for units. Youngson's, Inc., 6701 Melrose Ave., Louisville, KY 40216. 502-448-6228.

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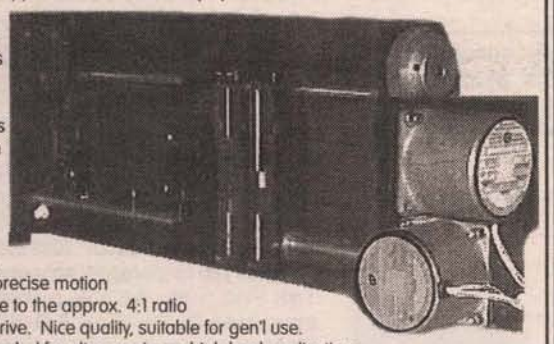
Heavy duty 3/8" diameter chromed steel rods provide up to 9 inches of linear travel. X drive is via a toothed belt powered by a SLO-SYN M061-LF-409, 1.25V@3.8A stepper motor with 200 steps per rev and 75 oz. in. hold. The Z axis is attached directly to the slide, provides 2 inches of travel and is powered by its own Rapidsyn 23E-6108BH 1.25V@3.8A stepper. 200 steps per rev and 60 oz. in. of hold. Very precise motion is possible due to the approx. 4:1 ratio toothed belt drive. Nice quality, suitable for gen'l use. Not recommended for ultra precise or high load applications. Removed from precision optical equipment. Overall size: 17"L x 6"H x 5.5"D Complete assembly mounted on a rigid 1/4" thick base. Ltd. Qty.



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CHECK THIS OUT! ULTRA MINI and WEATHERPROOF

Sold elsewhere in N&V for $249! Our "LIPSTICK" camera sets new standards. Sleek black anodized, aluminum, housing is O-Ring sealed and RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 16VDC @100mA, 3.7mm, 78° FOV lens, A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" leads.

GM-200K-STD...$149 power adapter...$4.95

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So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. A real glass lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. Think of the places you could put this little jewel. **GM-200K-PH lens,..$149 Pwr. module $4.95**

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Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. PH is 0.6"d, Both with 6" leads. **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS. **C-MOUNT** model now available. Only 0.9" d

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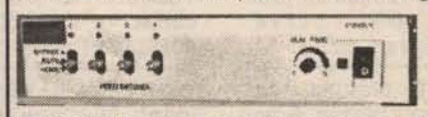

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Power out: 4.5mw max.
Range: 400-800 Meters
Glass Collimator
Size: 0.41"diam.x0.7"L

Shown Actual Size

650nm 5X Brighter...$45
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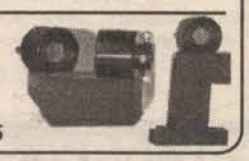

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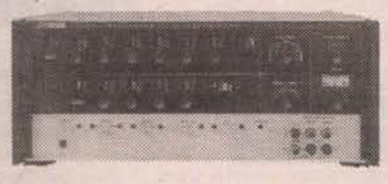

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Special $1100.00

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$175.00

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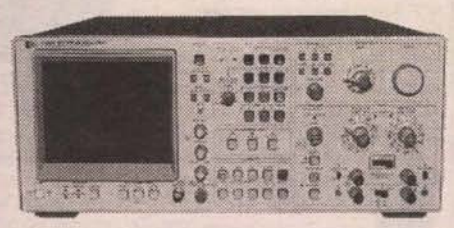

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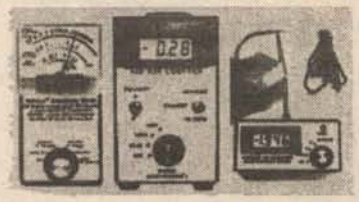

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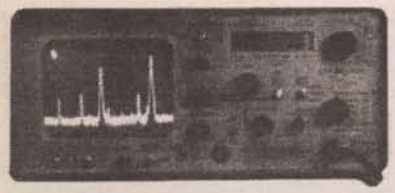

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by Kenton Chun

PIR Varmint Chaser

Unless you live in a condo, you probably have had problems with varmints in your yard at one time or another. It may be stray cats or dogs, or even the occasional unwelcome solicitor! In addition to rabies, varmints are known to carry and transmit infectious diseases and are a transport vector for blood sucking parasites and hitch hiker weeds.

Of course, it is unlawful and inhumane to resort to violent measures, and trapping and relocating varmints will not work in the long run because the varmint population is actually dependent upon the available food supply in the neighborhood.

Well-intentioned, but misguided "feeders" will tend to support a permanent population of stray animals. Removing the varmints will only leave a vacancy for others to take their place.

No varmint likes to get wet. Survival depends on retaining body

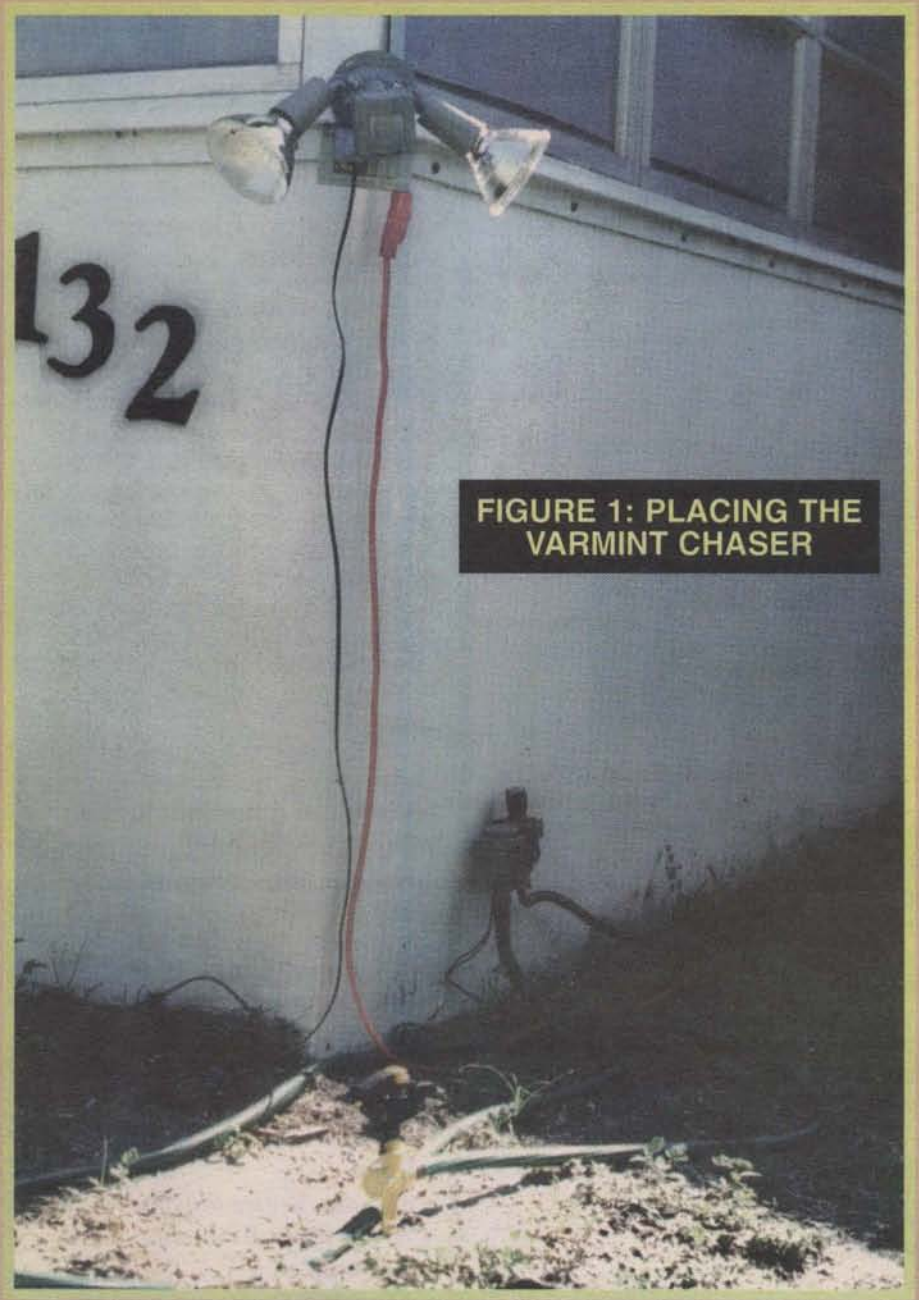

FIGURE 1: PLACING THE VARMINT CHASER

heat so dogs, cats, and other wild animals have an instinct to avoid being soaked.

This month's project will use a Passive Infrared (PIR) sensor to trigger open a solenoid valve which, in turn, is connected to a common yard sprinkler. When aimed at the area you wish to protect, varmints will steer clear!

The local chapter of the ASPCA confirms that this is an acceptable and humane method of deterring trespassing strays. Stray animals usually possess enough intelligence to realize when they are not welcome. The PIR varmint chaser will drive the point home without hurting them and may result in a greener lawn as well!

Passive Infrared (PIR) detectors have recently become cheap and plentiful. Advances in logic circuitry and infrared lensing systems have made them remarkably reliable and immune to false alarms. Most PIR sensor technology has been applied in automatic home lighting and commercial alarm systems.

These are sensing systems that sense the presence of a warm-blooded entity and turn lights or alarms on in response. PIR detectors actually sense changes in far infrared, at frequencies associated with heat.

A typical PIR sensor consists of a comparator amplifier that is looking at the outputs of a reference voltage source and an infrared detector diode. After a settling period, the voltages are static and the detector is armed. When something warm like a raccoon, a person, or even a warm car hood passes in front of the detector, the voltage fluctuates.

A plastic Fresnel lens designed to focus the infrared on the detector will modulate the signal as the target moves. If the sensing circuitry decides this is a valid event, a relay is triggered into an "on" state.

Usually the relay is connected to lighting which turns on as the intruder is detected. In the case of potential burglars, the lights coming on is usually enough of a deterrent to stop the advance. In the case of varmints, more convincing may be necessary.

Most varmints are nocturnal. They tend to patrol their perceived territorial boundaries (your yard) at night. This makes the PIR detector ideally suited for detecting and deterring nighttime prowlers.

Getting Started

The heart of the project is a commercially-available PIR lighting assembly. You can also use a PIR detector available from parts suppliers in this publication. Check the advertiser section for sources. PIR light assemblies can also be obtained from your local mega-hardware store. They come in various configurations, but the one we're looking for does not have to be an expensive model.

Higher cost models have light sensors built in so that they absolutely will not come on during the day. Bear this in mind if you want the unit to chase varmints all day, as well as all night.

Look for one that is rated for outdoor use — it should come complete with a weatherproof fixture and junction box suitable for use in damp locations.

You will also need a automatic sprinkler solenoid-operated valve. These normally closed valves are used to control branches of underground sprinkler systems. They typically come in one of two voltages, 24 VAC and 117 VAC models. If you decide to use the 24-VAC version, you will also need a 24 VAC transformer or wall wart.

Wire the passive infrared detector according to the manufacturer's instructions. AC wiring conventions are different than DC conventions! In home AC circuits, the black wire is hot, the white wire is neutral, and the ground wire is green. Remember, "Black Is Dead."

In order to make the unit portable, I wired the PIR assembly to a standard grounded outlet box attached directly to the lamp assembly. If you are using correctly polarized plugs, the narrow plug slot is the hot one.

Make sure to cut the power at the breaker box before opening any junction boxes, or working on house circuitry. House current can be lethal. Do not cheat – connect all grounds.

It is suggested that you go ahead and wire in the outdoor lamp assemblies according to the manufacturer's instructions. The switched hot lead from the detector will be red (Figure 3). Wire the outlet to the red (switched hot) and white (neutral) wires.

You may decide not to use the lamps, but we have discovered that stray animals will begin to associate getting soaked with the light coming on and eventually will flee in response to only the light!

Wire the solenoid valve with five or 10 feet of 14-18 gauge outdoor wire, or extension, if you are using an outlet box. This will give you some latitude for locating the water supply away from the lamp assemblies. When the assembly is complete, it should look something like (Figure 2).

Mount the PIR assembly on a "C" clamp so that it can be attached to any stable object in the

FIGURE 2: PIR AND WATER SOLENOID VALVE UNIT

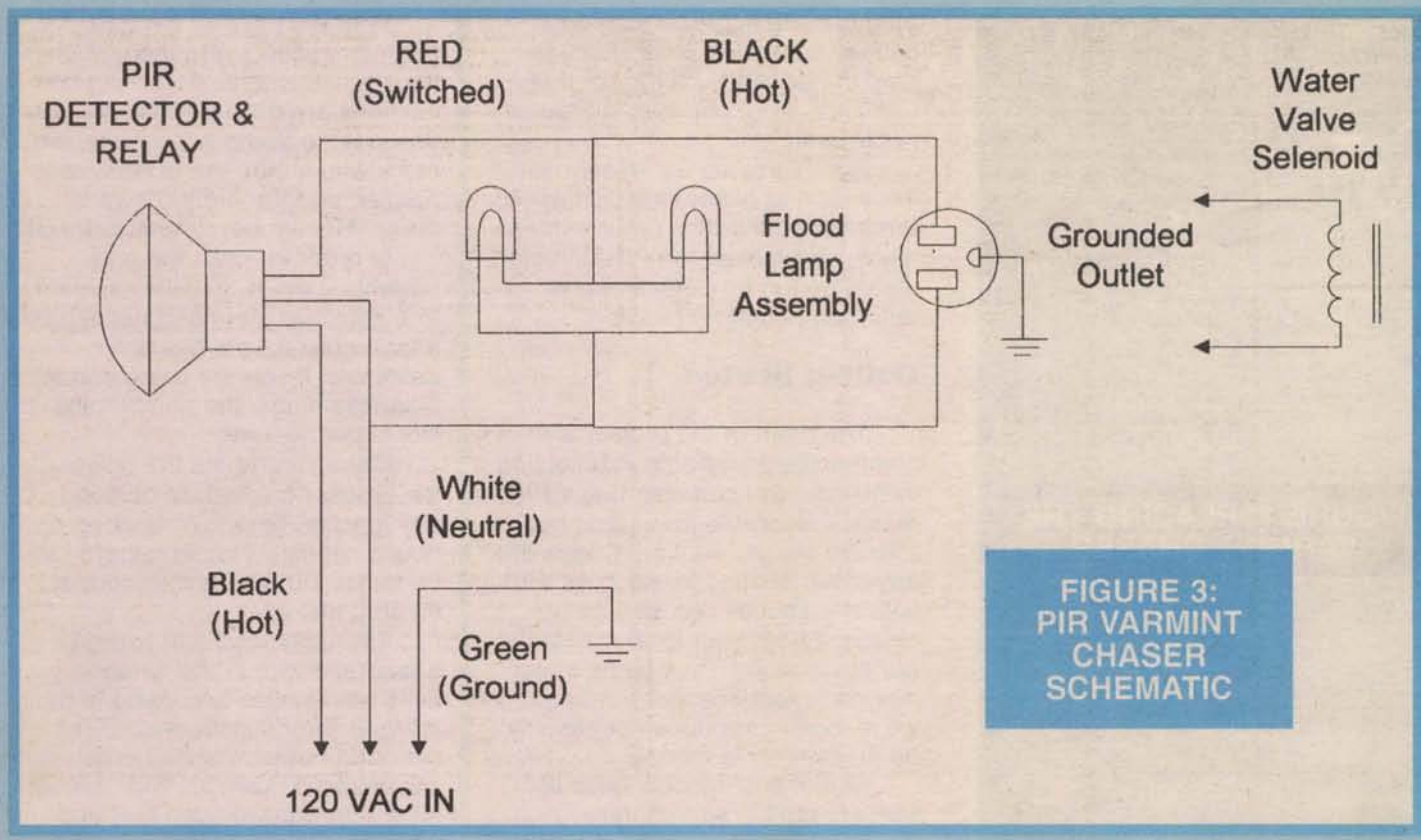

FIGURE 3: PIR VARMINT CHASER SCHEMATIC

vicinity to be protected. The solenoid valve does not have to be attached to anything. Finally, using double-female washing machine supply hoses, connect the input of the solenoid valve to your hose bib, and the output to a garden sprinkler.

We have found that the most effective sprinklers are the spring-loaded impulse clapper type, or the whirling turbine type. These have quick start-up and are fairly noisy, which helps to startle the intruders.

It would be a good idea to power the project with a GFCI-protected outlet or branch circuit breaker since water is involved. If you are using the 24-VAC version of the solenoid and have the transformer located well away from the PIR and water supply, the arrangement is pretty safe as it is.

Placing the Unit

Place the unit in an area that varmints are known to frequent. Study your varmints — they will usually enter and exit your property through a consistent path of least resistance. The best arrangement is pointing down a long pathway that is typically used by varmints to enter your yard.

Next, position the sprinkler 20 feet or so ahead of the PIR sensor. Impulse-type sprinklers usually have a stake attached so that they can be conveniently placed at different locations on the lawn. You will have to adjust the position of the stake and the pattern of the sprinkler to cover the area you wish to protect (Figure 1).

Finally, power up the PIR light assembly and turn on the water. The sprinkler may start up if the PIR model you have selected goes through an initialization cycle. Set the sensitivity so that the unit is not triggered by passing cars, or neighbors hanging out laundry.

Usually the duration can be set to anything under one minute. It would take a fairly stubborn varmint to wait around any longer than that. Even if that is the case, the unit will catch them when they advance again.

Conclusion/Alternate Applications

The PIR Varmint chaser is a humane method of deterring strays from using your yard as their personal litter box. The yard will look a lot better as well. If you do not have a varmint problem, the project is easily adapted to trigger on a video camera for video surveillance, a scary music tape for trick-or-treating Halloween goblins, or even a camera for nighttime photography of wild animals. I have used the PIR varmint chaser for all of these purposes with great success.

Use your imagination to think up new uses for the PIR varmint chaser, and remember to have fun, whatever you do! **NV**

Parts List:

- **PIR Sensor & Lamp Assembly (See Text)**
- **120 VAC Solenoid Normally Closed Sprinkler Valve**
- **F-F Washing machine Supply Hose**
- **Impulse Sprinkler (See Text)**
- **20' Outdoor Extension Cord**
- **C-Clamp**
- **Assorted crimp connectors, hardware as needed**

TEST EQUIPMENT *cont.*

EQUIPMENT SALE: RE 204 audio analyzer $400. Leader LPS-152 DC tracking supply $200; LSW480-U80 Swemar gen. w/TV-VIF plug-in $175; EIP 451/P1/P2/P5 auto microwave counter $600, option P2 only $450; **Boonton** 92SD $125; Fluke 8000 DMM $60; Philips PM-3217 o-scope $200; **Kikisui 5042** 50 MHz 4 ch. o-scope $200; NJE 0-20V, 0-1A bench supply $50, 6 available. New unused PTS 160 test source and 320 test source $175 each. **Psitech Plus** 707-745-4804, Fax 707-747-5277. E-Mail: apeas@ix.netcom.com

FLUKE 1722A instrument controller, $275; 8520A 5-1/2 digit multimeter, HPIB, $250; HP 3722A noise generator, $125; 3462A DVM, $75; 741A AC/DC differential voltmeter/DC standard, $75; 5314A counter, $60; General Radio 1925 multifilter, $150; 1551B sound level meter, $100; Nicolet UA-500A ubiquitous spectrum analyzer, $125; Krohn Hite 3321 filter, $80; Leeds & Northrup 7553 potentiometer, $50; Data Precision 3500 DVM, $50. The following $25 each, non-working or untested: Gould K100D; HP 466A amplifier; Tek R564B; Krohn Hite 400-CR low frequency oscillator; General Radio 1219A. Kent, 515-232-7528.

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SALE: TEK 465M 100MHz scope, good working condition, sale priced at $195. ISA, PO Box 6955, Laguna Niguel, CA 92607. 714-488-0010, Fax: 714-488-0299, E-Mail: sklar@cerfnet.com

FLUKE 8810A, 4.5 dig DVM, $250; Fluke 8000 DVM, $80; Esterline Angus Speed Servo II, dual channel chart recorder, $400; HP 7100B 2 ch. chart recorder, $300; HP 7132A dual channel chart recorder, $400; HP 7045B XY plotter, $400; Leeds and Northrup 6 decade universal ratio set, $500, GR 1608A Z bridge, $400. A-comm Electronics 303-290-8012.

WANTED: TEKTRONIX type 212 oscilloscope. Allan Weiner, 207-985-7547.

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ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware and software. This column doesn't replace the Tech Forum that you've grown to love and support. Instead, it will supplement it, so feel free to participate as always with your questions and answers. You can reach me online at QandA@nutsvolts.com, or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

What's Up:

Dueling DSS receiver dilemma resolved, seeking obsolete replacement parts, and LM3914 basics. Windows 95 tips and tricks, selecting a video controller, and reader feedback on stepper-motor controllers.

Resistor Basics

Q. Kenton Chun's doorbell lamp ("Forever Doorbell," Feb. 1998) was a cute idea, but I wonder about the power dissipation in the dropping resistor; i.e., his 1/8 watt resistor at 600 ohms might not be up to the task for long. I once encountered an old, home-brew, control panel at work, which used 1/8 watt resistors to drop 12 volts DC for an LED. The LEDs had the right voltage across them, alright, but there was no light! A simple ohmmeter test showed that the LEDs had survived over the years, but the resistors had cooked and changed their value radically upward. As a result, the voltage was right, but the current was now below the point of a visible glow. Now the way I calculate it, 30 mA (per Mr. Chun's math) through 600 ohms works out to just over 1/2 watt. And considering the 99.999% duty cycle on the bell lamp, it looks like there could be some toast coming there, too. What do you think?

Jim Tolson
via Internet

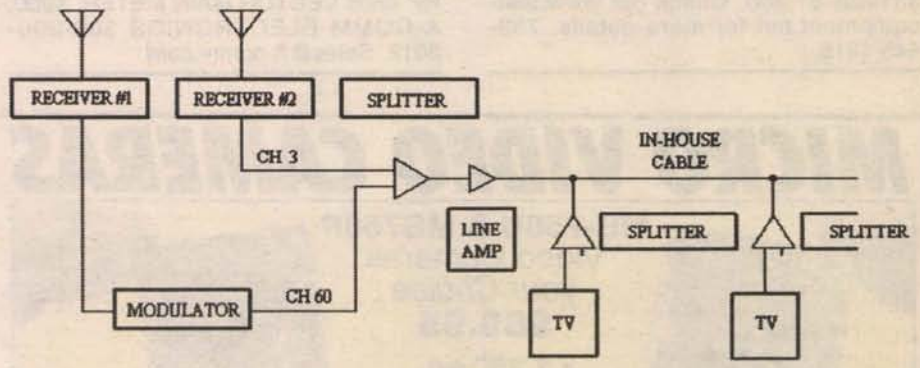
A. *Well, let's analyze the two designs. Let's assume that the LED drops 2.1 volts in the forward mode (some have a larger voltage drop, others have less – it depends on the color and construction). If the LED is powered from a 12-volt source, as in your example, then the 600-ohm resistor has to drop about 10 volts. Using Ohms Law, we discover that 10 volts through 600 ohms equals 16.6 mA (I = E/R = 10/600). Let's call it 17 mA. Power is current times voltage, or P = EI. So, in this case, the resistor needs to dissipate 0.017 mA x 10 volts, or 0.17 watts. The last time I looked, a 1/8-watt resistor equals 0.125 watts. This design clearly calls for a 1/4-watt resistor (0.25 watts), not the 1/8-watt resistors you uncovered. Bad engineering! Now, according to Kenton Chun's article, he worked from an 18-volt AC power source. Without going into a lot of detail about RMS and diode rectification, we can assume we have the equivalent of 9 volts DC. Running this formula through Ohms Law again, we get 7 volts across 600 ohms, or about 12 mA. Multiplying 12 mA by 7 volts nets a power dissipation of 0.084 watts – well within the design limits of any 1/8-watt resistor. The bottom line is that even though Mr. Chun's math was in error, the resistor will survive. Your home-brew friend missed the boat. My concern with the doorbell light is that the LED will survive the peak reverse voltage (most LEDs have a Vr of just 5 volts).*

Agil Modulator Solves DSS Dilemma

Q. I have a Digital Satellite System (DSS) at home with two receivers: one (located in the family room) serves the family room and master bedroom, and the other (located in one of the kid's rooms) serves my two children's bedrooms. One receiver outputs on channel 3 and the other on channel 4. I want to tie the two cable "systems" together so that any television can watch what is on either receiver. Unfortunately, the receiver output channels are so close together that I get crosstalk (bleedover) when I connect them together. I've tried every trick in the book, but I can't keep the two receivers from interfering with each other. What I need is a circuit that will prevent this from happening. Any suggestions?

Robert R. Stapp
via Internet

A. *I'm not surprised that you're having trouble with crosstalk using this strategy. The channel 3 modulator inside your DSS receiver lacks the expensive filtering of broadcast modulators; hence, the signal is "wider" than it should be and channel 3 will spill into nearby channels, including channels 2, 4, and 5. What you need is an "agil modulator" – sort of a video frequency converter. This device converts channel 3 (or channel 4) into channel 60 (439.250 MHz). Now you can mix the two DSS receivers without interference. You view Receiver #1 on channel 60 and Receiver #2 on channel 3. The diagram below shows you how to cable it together.*



In this arrangement, the output of the modulator and Receiver #2 are mixed together in an ordinary cable splitter (Radio Shack 15-1141) that's been turned around so that the outputs are inputs and the input becomes the output. The mixed signals are then amplified using a standard line amplifier (Radio Shack 15-1112). The amplifier is necessary to make up for losses in the splitters and cable length, so don't skip it. Now you can use a single cable to provide service to every set in the house. Agil modulators are available from most DSS distributors, including ***Radio Shack, Satellite Warehouse (800-851-6534; http://www.dbs-online.com/index***

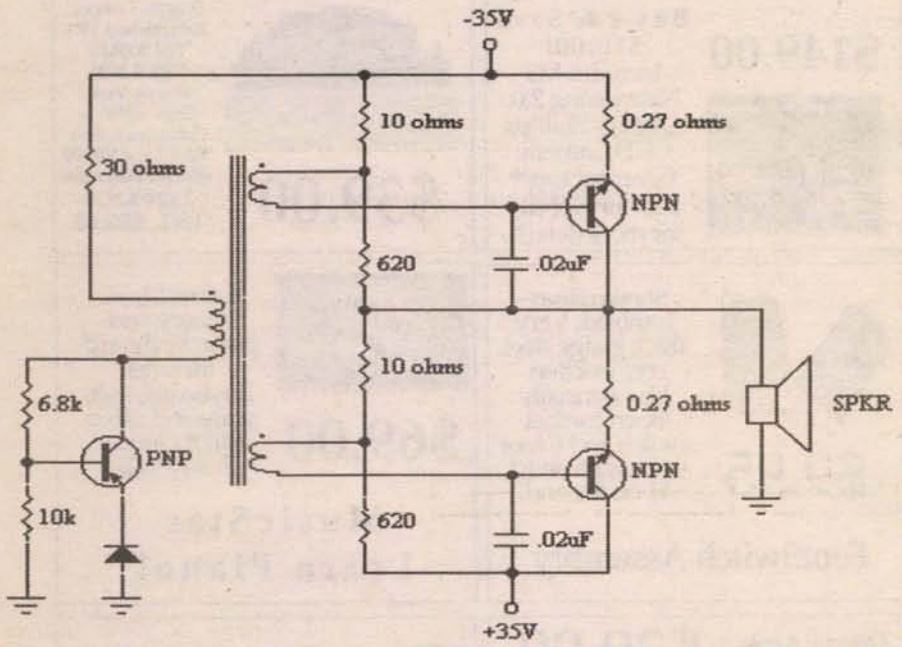
***.html)**, and **Star Link (405-745-9222; http://www.starlink-dss.com)**. The most popular modulators are ChannelPlus 3024 ($250.00), MMOD70 ($140.00), Sony MRD-D1, Triple Play ($230.00). BTW, I bet you don't know that the channel 3 output of your DSS receiver is mono, not stereo! If you want stereo sound, you'll have to plug the audio output of the DSS receiver into a stereo amplifier.*

Matched Transistor Pair Needed

Q. I have an old Sears Silvertone Musical Instrument Amp (Model 185.12010) that quit working. I traced the problem to a pair of output transistors that gave up the ghost. Unfortunately, Sears no longer supports or provides parts for this amplifier, and the problem is that these transistors have to be matched! Help!

K. Ramses
Coshocton, OH

***A.** Thanks for sending a copy of the schematic so that I can show other readers what to expect in similar circumstances. This is a very common design that came out in the late 60s when power ICs, like the LM1877, were but a dream. If you have an old stereo amplifier, you'll discover the same circuit.*



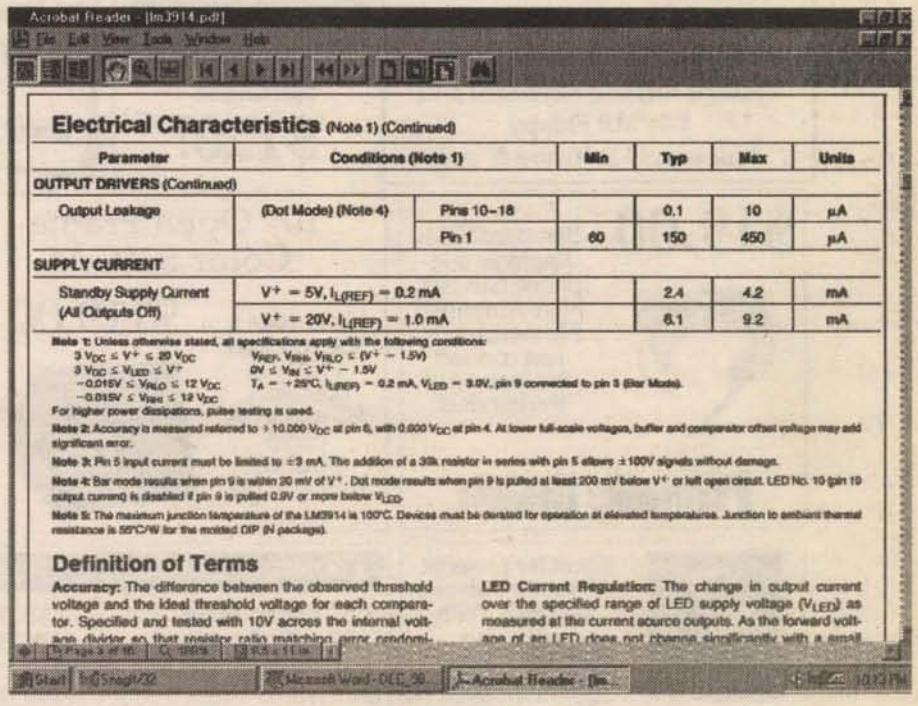
The concept is a balanced positive-to-negative heavy current swing that relies on the perfect match of the two high-power transistors. Notice that each transistor is driven by a separate transformer winding. When properly matched for leakage and bias current, the connection junction of the two transistors rests at zero volts with zero signal input. Also notice that there's a small-value resistor (0.27 ohms) connected to the emitters of the two transistors. Often this is a fusible resistor that purposely blows out to prevent damage to the speaker when one of the transistors fails – so pay attention. The resistors may be dead, too. Now there's a good news and bad news part to this story. The good news: As for a suitable replacement, the NTE130MP, ECG 130MP, or their equivalent are perfect replacements and are sold by many local jobbers. The bad news: Expect to shell out about $30.00 to $50.00 for the matched pair, and don't expect them to be in current stock (probably a two-week wait).

Check Out The Specs

Q. I have a question that has puzzled me for sometime. When using an LM3914 in the dot mode, why does the first LED always seem to glow just a tad? That's the one that is connected to pin 1 of the LM3914 and is the "low end" of the display. In the bar mode this doesn't seem to happen

Mike Bryce
via Internet

***A.** First LED ... hmm? Actually, the answer is quite simple: It's the nature of the chip itself, as the data sheet below shows. Notice that the leakage current on pin 1 is considerably greater than the other outputs.*



Electrical Characteristics (Note 1) (Continued)

Parameter	Conditions (Note 1)		Min	Typ	Max	Units
OUTPUT DRIVERS (Continued)						
Output Leakage	(Dot Mode) (Note 4)	Pins 10–18		0.1	10	µA
		Pin 1	60	150	450	µA
SUPPLY CURRENT						
Standby Supply Current (All Outputs Off)	$V^+ = 5V$, $I_{L(REF)} = 0.2$ mA			2.4	4.2	mA
	$V^+ = 20V$, $I_{L(REF)} = 1.0$ mA			6.1	9.2	mA

Note 1: Unless otherwise stated, all specifications apply with the following conditions:
$3\ V_{DC} \le V^+ \le 20\ V_{DC}$; $3\ V_{DC} \le V_{LED} \le V^+$; $-0.015V \le V_{HLO} \le 12\ V_{DC}$; $-0.015V \le V_{MHI} \le 12\ V_{DC}$
V_{REF}, V_{RHI}, $V_{RLO} \le (V^+ - 1.5V)$; $0V \le V_{IN} \le V^+ - 1.5V$; $T_A = +25°C$, $I_{(REF)} = 0.2$ mA, $V_{LED} = 3.0V$, pin 9 connected to pin 3 (Bar Mode).
For higher power dissipations, pulse testing is used.

Note 2: Accuracy is measured referred to +10.000 V_{DC} at pin 6, with 0.000 V_{DC} at pin 4. At lower full-scale voltages, buffer and comparator offset voltage may add significant error.

Note 3: Pin 5 input current must be limited to ±3 mA. The addition of a 39k resistor in series with pin 5 allows ±100V signals without damage.

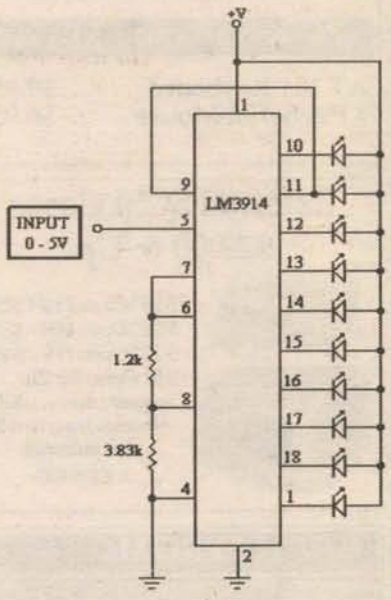
Note 4: Bar mode results when pin 9 is within 20 mV of V^+. Dot mode results when pin 9 is pulled at least 200 mV below V^+ or left open circuit. LED No. 10 (pin 10 output current) is disabled if pin 9 is pulled 0.5V or more below V_{LED}.

Note 5: The maximum junction temperature of the LM3914 is 100°C. Devices must be derated for operation at elevated temperatures. Junction to ambient thermal resistance is 55°C/W for the molded DIP (N package).

Definition of Terms

Accuracy: The difference between the observed threshold voltage and the ideal threshold voltage for each comparator. Specified and tested with 10V across the internal voltage divider so that resistor ratio matching error predomi-

LED Current Regulation: The change in output current over the specified range of LED supply voltage (V_{LED}) as measured at the current source outputs. As the forward voltage of an LED does not change significantly with a small



To reduce (not eliminate) the effect, National Semiconductor recommends that you return pin 9 (MODE) to pin 11 (LED 9) instead of letting it flap in the wind (open). Try this circuit and see if it works better.

(Continued on page 102)

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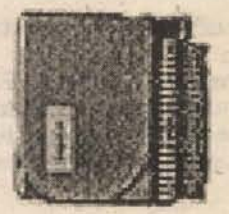

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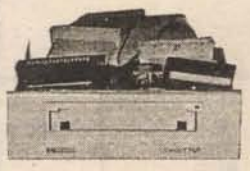

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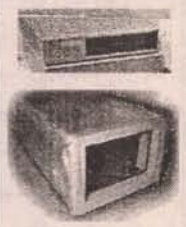

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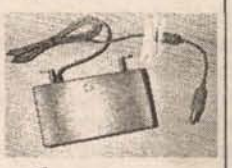

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What They Didn't Teach You ... If They Ever Even Knew!

Open Channel

by Joseph J. Carr, CET
K4IPV

In the late 1970s, an electrical engineering professor in a major east coast university was teaching an undergraduate "electron devices" course (transistors, diodes, op-amps, etc.). He made the following statement: "The nice thing about electronic engineering, that's not true for the other fields, is that if it works on the blackboard it has to work on the bench." He meant it! And he also didn't quite get it when about one-third of the class burst into hysterical laughter. The rest of the class sat around quizzically wondering why the others were laughing their heads off.

Guess which of the two groups had some technician level experience prior to entering engineering school? The dudes that were laughing so hard had made their living either repairing products that should've worked because they worked on the blackboard, or debugging newly created circuits that didn't work on the bench the way they worked on the blackboard.

The Great Bob Pease, who proves that engineers can be both curmudgeonly and have a sense of humor, writing in one of his delightful "What's All This _____ Stuff, Anyhow?" articles, made the heretical suggestion that engineering schools only hire professors with years of engineering experience. I once told a friend of mine, who was an engineering professor, that most engineering school professors are not engineers because they had never practiced the profession except for "research." The doc who made the "... works on the blackboard" statement went through from high school to the Ph.D level to the professoriate without ever practicing the profession (senior projects, thesis, and dissertation projects are not quite the same thing).

At one time, in many states, a person could not teach a profession unless they were licensed to practice it. The Professional Engineering (PE) license typically requires at least four years of "... progressively more responsible experience." That means that PE's who become professors have at least four years of experience. I recall one engineering school where nearly all of the EE professors had PE licenses. In another school, less than 100 miles away, so few professors had PE licenses that a senior (friend of mine) who needed to acquire the five signatures needed on the PE exam application, had to go outside the school to find them! They didn't even have enough PE's on the faculty to form a pick-up basketball game.

Among the things you are unlikely to learn in engineering school are the practical things that make a project successful. Many engineering professors see these as "trade school" topics, and leave them to the vo-techs. What they don't understand – never having practiced the profession – is that they are also what makes the project successful. Let's take a look at a few actual events.

The Case of the Student's Rat's Nest Project

When I was in engineering graduate school, I worked in the university's hospital repairing equipment (electronic repair techs made three times what a graduate teaching assistant earned!). One day, came a knock-knock-knock on my workshop door, and upon opening it, I found a genuine undergraduate engineering student. "Doctor Frabbitz[1] said you'd help me with my senior project." Since Doc Frabbitz was my academic advisor, and therefore held the key to my entire professional future, I allowed as how I might help the young fellow (sighhhh).

([1] Not his real name!)

The chap came into the workshop carrying a box of goodies. He showed me a scrawled circuit on several pieces of green "engineering paper." I forget at this late date what the circuit did, but it contained a large number of the then-current TTL digital devices and some LED seven-segment numerical readouts. Then he brought out his circuit. Oh, my god, what next? That circuit was a rat's nest built on a chunk of wood. The TTL chips were soldered in "dead bug" style, and all interconnections were made with #26 or #28 enameled wire, with the ends more or less scraped to reveal the underlying copper. The circuit was clocked at about 4 MHz, if I recall correctly.

The fellow also failed to use any capacitors in the power supply distribution circuit. Take a look at Figure 1. Those TTL chips drew a lot more current than today's chips, so putting a 0.01 µF to 0.1 µF at each chip was essential (C2 through C4 in Figure 1). It's still important, but then it was critical. There should also be a capacitor at the point on the circuit board where the DC power supply lines connect (C1 in Figure 1). In some cases, where the power supply lines are long or there are a large number of devices on the PCB, then there should be additional capacitors on the DC power lines as well.

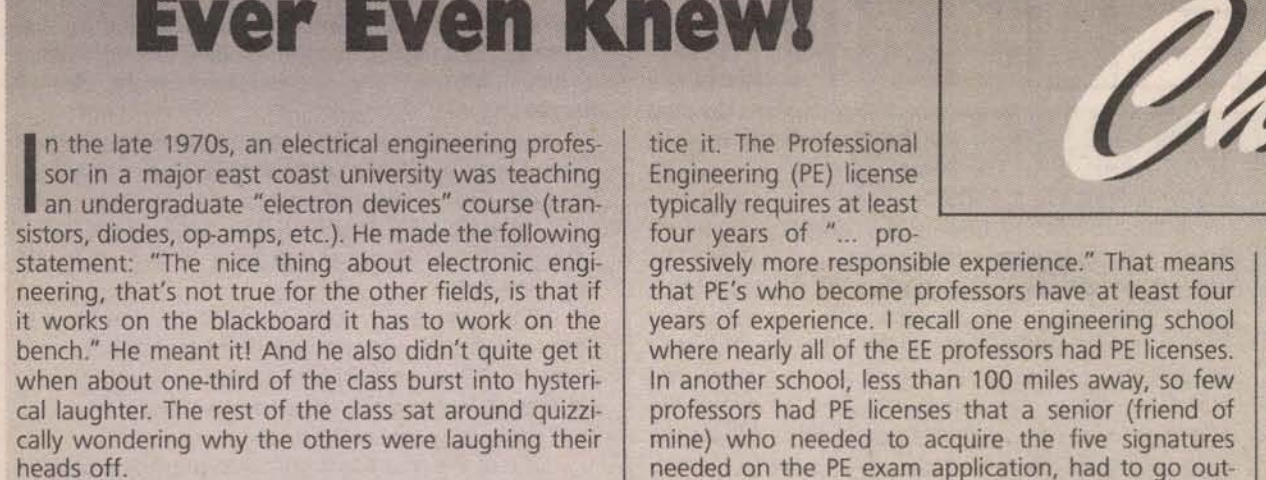

Figure 1.
Using decoupling capacitors at each chip is a must.

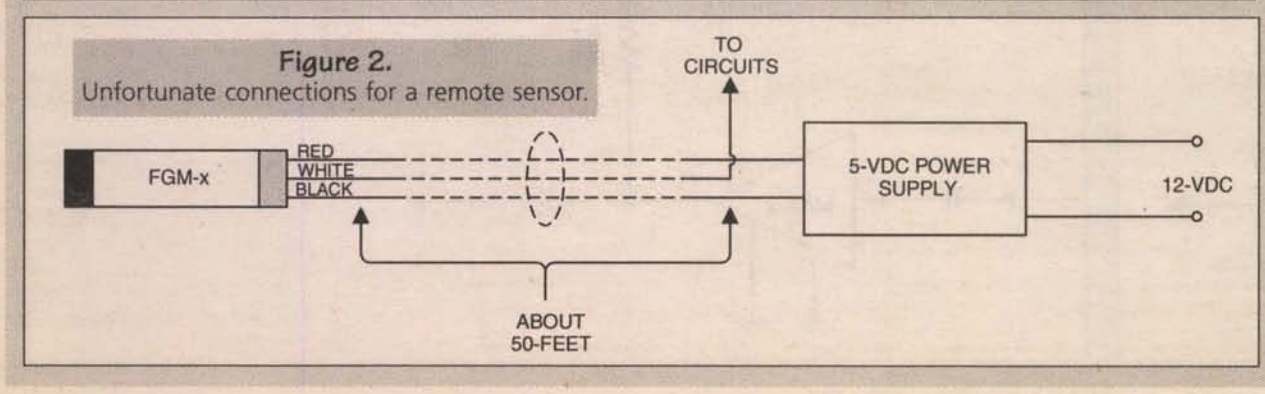

Figure 2.
Unfortunate connections for a remote sensor.

The Case of the Long Lines

My friend Erich Kern of Fat Quarters Software (who supply the FGM-x magnetic sensors) put me up to writing on this topic right after one of his sensor customers reported having a problem or two. The chap wanted to put an FGM-3 sensor about 50 feet from the DC power supply and signal processing circuits (Figure 2). He ran a set of wires between the two, and found erratic behavior. Eric told him to at least put a 10-µF capacitor between the black and red DC power supply leads on the FGM-3 (which is what the spec sheet says to do!). He also recommended what I believe is the correct solution (Figure 3).

The +5 VDC voltage regulator and capacitor ought to be at the sensor end of the wire run, and the wire should be shielded. With sensitive instruments like a magnetic sensor, one might also want to consider a dual-regulated DC power supply.

The Case of the Burned-Out Pre-amp

Another practical problem came about from one of my articles in this magazine. I am a fan of the Mini-Circuits MAR-x monolithic microwave integrated circuits (MMIC). They are chips that operate from near-DC to either 1,000 MHz or 2,000 MHz, depending on the specific type number (which is what the "x" in "MAR-x" means). I typically use the MAR-1 and MAR-6 devices. One of the nice things about the MAR-x devices is that they have an inherent 50-ohms input and output impedances, so match well with other RF circuits and coaxial cable.

A fellow contacted me about the MAR-x preamplifier he had built for his VHF/UHF scanner receiver. That's a good application for the MAR-x. He

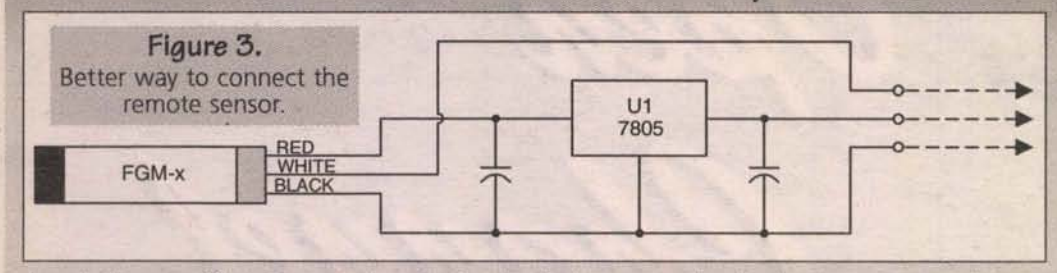

Figure 3.
Better way to connect the remote sensor.

placed the amplifier right at the terminals of the antenna, up in the attic. The amplifier was used to overcome coax loss and to boost the signal received through the antenna. He complained bitterly that the MAR-x was a "no good product" because he had to replace the chip every three or four months. That didn't seem quite right to me because I've used MAR-x devices for years, not months, and never had a failure.

He sent me a schematic (Figure 4A) showing the MAR-x preamplifier connected to an unregulated DC power supply that was nominally rated 36 VDC, but actually varied between 30 VDC and 40 VDC depending on the load, the line voltage, and the phase of the moon (I suspect). He used the normal series limiting resistor (R1 in Figure 4A), making it 1,500 ohms. The idea is to drop the voltage to +5 VDC, while staying within the current rating. If the voltage stayed right at 36 VDC, the current drain through the MAR-x would be around 21 mA.

The particular MAR-x device he used nominally wanted to see 3.5 volts (V1 in Figure 4A), with the 5 volts he used being at the upper limit. When the voltage supply raised to 40 VDC, the value of V1 went higher than the rated voltage. I recommended that he place a low current 78L05 voltage regulator up in the attic in the same box with the MAR-x device (Figure 4B). He did so, and reported to me a year or so later that the problem went away. The device turned out to gain reliability when he operated it within specs.

A better solution would be to reduce the unregulated supply voltage to 9 to 12 volts, or so. Or one could use dual regulation by using a 78L09 or 78L12 at the lower end of the DC power supply wire, and a 78L05 at the MAR-x pre-amp in the attic.

Component Tolerances

One of the many reasons why circuits don't always work on the bench like they work on the blackboard is the little issue of component tolerances. When you buy transistors, you will find the beta gain listed with "min-typ-max" values. This means that the value will be between the minimum and maximum values and, if you are lucky, will be close to the "typical" value.

Similarly with resistors: A resistor with a "five-percent tolerance" can have a value that is (five percent of the value written on the body. Suppose you have a resistor marked "1,000 ohms, 5%." The actual value can be 1,000Ω ± 5%, or 950Ω to 1,050Ω.

Figure 5 shows how such components might graph if you measure some critical component. The vertical axis shows the proportion of the total number at each value. We are assuming that the values form a normal distribution curve, although they may actually form some other curve. The minimum and maximum values are usually selected as either the $\pm 2\sigma$ or $\pm 3\sigma$ points, while the typical value will be the mean value. We tend to design circuits using the typical value, and sometimes don't take into consideration what the implications are of a particular component being closer to min or max values.

I've seen several different problems associated with the fact that actual component parameter values have a range. One such problem is the matter of tolerance build-up. In circuits that are reasonably robust, the effect of component variation will not be too terrible, especially if the variation is more or less randomly distributed. But every now and then, one will find a situation where all the values selected for some particular project pile up at one end of the range or the other. Some might be high, and some might be low, but if they combine to the values that make the circuit work poorly, then ... all bets are off.

Another problem was seen in a low-noise amplifier used in the UHF spectrum. The original circuit breadboarded by the engineer used a transistor that had a critical parameter close to the $+3\sigma$ point on its distribution curve. He optimized the circuit, and got it working real well. Unfortunately, the next one didn't work too terribly well. It seems that most of the transistors of that part number in the supply room box were closer to the mean point on the scale. The device he picked out happened to be atypical for the group.

The Changing Environment

Okay, so you learn the techniques of breadboarding, and get a super circuit working properly. Unfortunately, the final circuit will not work in a laboratory environment. It will, instead, go out into a hard, cruel world. The ambient temperature might not be so nicely regulated as it was on your workbench.

I know some people who design avionics equipment. Do you have any idea how much the temperature changes from ground level to cruising altitude? Sitting at the Tucson International Airport, on a hot July day, the ambient temperature above the runway might be 130 degrees as the airplane lifts off. When it hits "altitude," the temperature might be -40 degrees.

In World War II, B-17 bomber waist gun crews knew not to touch the walls of their planes ungloved because their fingers would freeze in place (great place to have your trigger finger when a Luftwaffe Messerschmidt 109 was stitching a line of bullet holes in you).

When you design circuits for them, you have to account for such variation. How do you handle such problems? One method is to create a closed environment that can be either heated or cooled as needed. That's probably the best solution.

One of the first times I ran into thermal problems in a big way was when car radios first became all-transistor (early 1960s). I was servicing car radios in those days (indeed, I feel positively old when I see models I worked on under warranty being listed as "classic cars!").

One major car radio maker had a real problem. Radios by the thousands were failing in an odd way. During the summer they would fail to work when the car first started, but would then pop on after a few miles. During the winter, however, they would also fail to work when the radio was first turned on. In other words, the radio failed when it was both hot and cold, so the engineers didn't initially think of a thermal problem. It turned out that they had a thermal problem on both ends of the temperature range. On hot days, either the vent or the air conditioner would cool the overheated radio off enough to make it work properly. On cold days, the heater would warm the radio up into the acceptable range. Changing the transistors from germanium to silicon units solved the problem.

Another odd problem popped up when a friend was servicing ancient scientific and medical instruments. One item had germanium transistors made in the early 1960s. When exactly the same part number was bought in the early 1990s, the circuit would either fail to bias correctly or would oscillate at a VHF frequency. Huh!?! It turned out that the original version of the transistors had a low-gain bandwidth product and a high-leakage current. The biasing resistors were set to accommodate the high-leakage current. When a modern unit was installed, with very low-leakage currents because of better metallurgy and fabrication, the values were all wrong.

The oscillation problem occurred because the

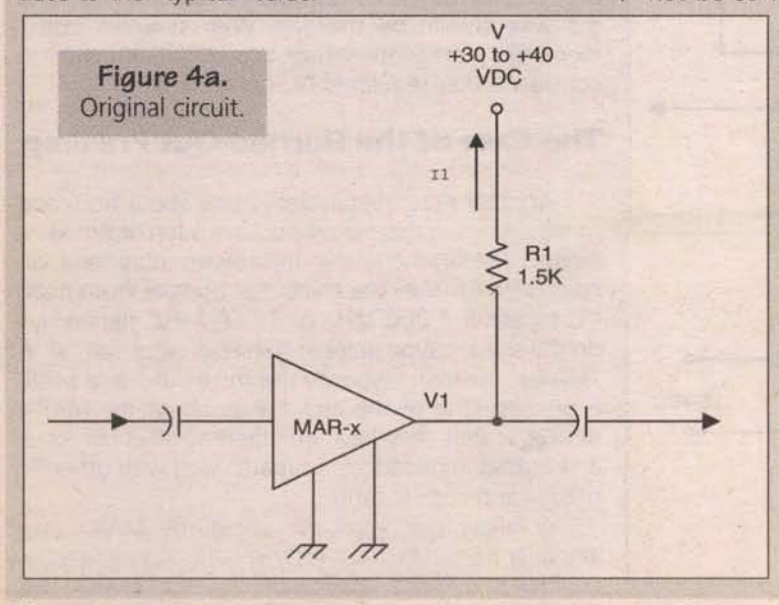

Figure 4a.
Original circuit.

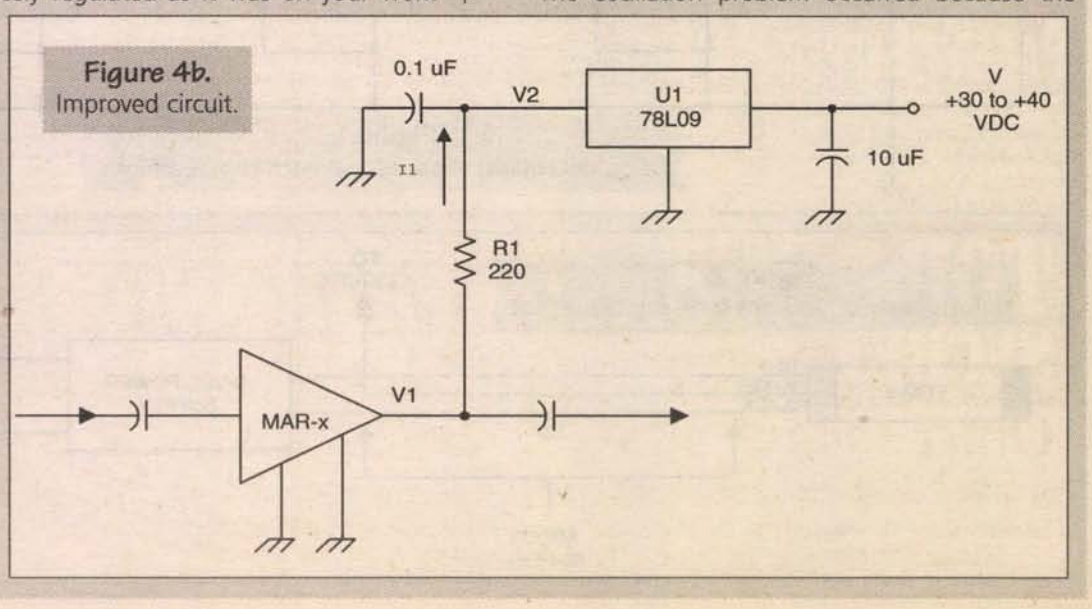

Figure 4b.
Improved circuit.

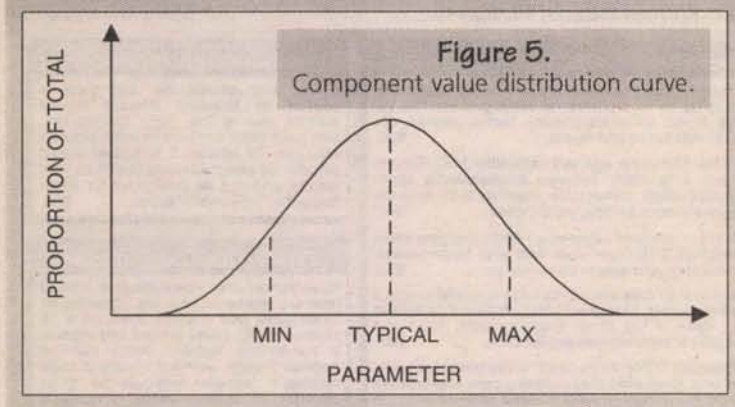

Figure 5.
Component value distribution curve.

new transistor had a much higher gain-bandwidth product than the original unit. Stray inductances and capacitances in the circuit that didn't have any effect originally now caused oscillation. Previously, the low gain at the resonant frequency of the "strays" prevented oscillation. Sighhhh.

Some Ham Radio Examples

I once had a kit-built HF SSB transceiver (not a Heathkit) that had a terrible heat drift problem. A couple buddies had solved the problem on their units. It seems that the shielded box holding the variable frequency oscillator (VFO) was right next to a series of three vacuum tubes of the IF amplifier and detector. As those tubes threw off heat, it changed the thermal environment of the poorly designed VFO. One of the more popular solutions was to put a heat shield of insulating material between the VFO and IF strip. It sorta worked ... in fact, it worked quite well compared to the previous performance.

Another problem surfaced when a fellow from Central America contacted me through one of my ham radio columns. He was an American who worked in the jungle as a missionary or something. He had a certain factory-built HF SSB transceiver that had a terrible frequency drift as the rig heated up. On SSB rigs, that drift is particularly problematic. He was looking for a new VFO, thinking the old one was defective. I had heard of this problem before, and quickly found out that it was generic to the particular product. Another technical writer told me that the rig had been designed by a very famous HF designer, and was therefore very surprised at the problem.

When I contacted the fellow, he was really ticked! That rig had a drift of less than 50 ppm/hour when it left his lab, but cost cutting production people had made some — errr — improvements. They changed the inductor's coil form from a costly synthetic material to ceramic, increasing its thermal coefficient of expansion. They also couldn't see why the designer specified Litz wire (which is hard to work) for the coil ... and replaced it with ordinary enameled wire. That also increased the thermal coefficient. They then took out the silvered mica DM-25 capacitors, polyethylene dielectric capacitors, and the disk ceramics with specified temperature coefficients, and replaced them with cheapo disk ceramics of uncertain parentage. The result: DRIFT! Fortunately, he still had one of the lab models in his possession, and graciously shipped it to the ham in Central America free of charge. Good work gone bad.

New Book

The most popular subjects I've written on in this and other magazines are radio astronomy, propagation studies, whistler and spheric hunting, VLF sudden ionospheric disturbance (SID) hunting, reception of Jupiter's natural radio signals, and so forth. I coined the term "radioscience observing" to cover all such activities. My new book of this title is now out. Howard W. Sams/PROMT Publishing has released *RadioScience Observing Volume 1* (ISBN 0-7906-1127-9, $29.95). The book includes a CD-ROM software program that performs antenna dimension calculations, plus gives examples of natural radio sounds (not to mention some original music composed by my wife, Bonnie, that incorporates whistler and pulsar sounds). Call **1-800-428-7267**, or order via Amazon Books on the Internet (http://www.amazon.com).

The environment imposes terrible burdens on the circuit designer. The temperatures can go up and down, vibration occurs (anyone remember the Heathkit VF-1 VFO ... it was vibration frequency modulated every time someone walked across the floor!), lumps, bumps, and bangs occur. And that's before we factor in component tolerances, stray inductances and capacitances, resistances in the connections, electrical noise, and a host of other problems. Yet they all have to be accounted for in the design ... and that's why the circuit doesn't always work on the bench like it works on the blackboard, professor. **NV**

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HP 141T, Spectrum Analyzer Mainframe $475
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HP 141T, Spectrum Analyzer w/8552B/8556A, 20Hz-300KHz ... $1,100
HP 141T, Spectrum Analyzer w/8552B/8554B, 1KHz-1.2GHz ... $1,700
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Tek 7B92A, Plug-in (500MHz), Dual Time Base $200
Tek 7D11, Plug-in Digital Delay $175
Tek 7D13, Plug-in DMM 3-1/2 Digit $125
Tek 7D15, Plug-in Counter/Timer, DC-225MHz $225
Tek 7S11, Plug-in Sampling Unit $175
Tek 134, Current Probe Amp $100
Tek 465, Scope (100MHz), Dual Trace $425
Tek 465B, Scope (100MHz), Dual Trace $475
Tek 466, Scope (100MHz storage), Dual Trace $575
Tek 475, Scope (200MHz), Dual Trace $475
Tek 475A, Scope (250MHz), Dual Trace $625
Tek 485, Scope (350MHz), Dual Trace $850
Tek 520A, NTSC Vectorscope $575
Tek 2213, Scope (60MHz), Dual Trace $375
Tek 2236, Scope (100MHz) w/Counter/Timer/DMM $800
Tek 2445, Scope (150MHz), 4-Channel Cursor Readout $1,700
Tek 2465, Scope (300MHz), 4-Channel Cursor Readout $2,400
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Tek 7704A, Scope Mainframe (250MHz) $325
Tek 7854, Scope (400MHz), Dual Beam w/Waveform Calculator . $625
Tek 7904, Scope Mainframe (500MHz) $350
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Wavetek 185, Lin Log Sweep Generator, .0001Hz-5MHz $425
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Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **$49**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection and auto re-transmission. **$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ascii character string. Example: *12/31 08:45 850-863-5723 Weeder, Terry <CR>*. Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **$35**

Touch-Tone Input - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. **$34**

IR Remote Control Receiver

Learns and records the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **$32**

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Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **$55**

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Reads frequency from 1Hz to 50MHz and displays up to 7 digits on a 16 character LCD. Auto-range feature provides floating decimal point and automatic placement of suffix (Hz, KHz, or MHz). Microcontroller based provides for very small parts count, only 2" x 3" big. **$46**

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Modern computing and standard surge suppressors... a recipe for disaster.

Almost all surge protection devices use MOV's (metal oxide varistors) as their active element. MOV's are sacrificial/wear/limited life components. Surge suppressors based on this technology are doomed to failure. These surge "suppressors" also don't suppress a thing. They divert powerline surges equally to the ground and neutral wire. When you put current on the common ground wire of interconnected equipment some of that current will flow (through the inherent ground loops) to the data lines. This is a major cause of lock-ups and misoperations that plague today's computer environments. Another fact; all modern computers use switch mode power supplies. During surges the power supply capacitors must charge to the clamping level of the MOV before the MOV turns on. A recent study has shown that it takes a 3000A surge 15 microseconds (15,000 nanoseconds) to charge the typical capacitors of these power supplies to that level. The surge is virtually over before the MOV reacts. ***(See five things you probably don't know about your surge suppressor at www.fivethings.com.)***

THE POINT: Standard surge suppressors allow too much current to hit the computer. Standard surge suppressors divert surge current to the ground wire and disrupt data transfer. Standard surge suppressors eventually fail without warning. Modern computers have logic voltage levels (the signals that transmit the data) and power supply voltages that are dramatically lower than that of their recent predecessors. Modern computers use integrated circuits with transistors of ever decreasing physical geometries. Modern computers are virtually always interconnected to other computers or peripheral equipment. The bottom line; ***modern computers are much more sensitive and susceptible to powerline anomalies.***

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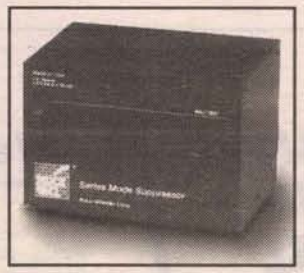
i.e.: A Brick Wall Will Not Fail.

We know of no cord connected, MOV based surge protection device that has, or can pass this test.



A Brick Wall possesses UL's lowest Suppressed Voltage Rating (let-through voltage) of 330V. This is the lowest rating they will grant. In that test of one thousand 6000V, 3000A surges, *UL NEVER SAW THE LET-THROUGH VOLTAGE EXCEED 290V. YOU CANNOT DO BETTER THAN THIS FOR A POINT-OF-USE SURGE PROTECTION DEVICE.* Once again, we know of no other surge protection device that could come close to this performance level.

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These devices were engineered utilizing a current limiting/surge filtering technology. *THEY DO NOT DIVERT ANY SURGE CURRENT TO THE GROUND WIRE. They Will Not Cause Your Computer System To LOCK-UP, CRASH OR MISOPERATE as a consequence of surge diversion. Your current surge "suppressor" will.*

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In addition to all this, Brick Wall Surge ***FILTERS*** *are the best AC powerline filters you can buy (that we have been able to find anyway). Industrial machinery, copiers, coffee makers, laser printers, fluorescent lights, refrigerators, etc., all cause powerline noise that can cause your computer to misoperate. A Brick Wall Surge Filter will make powerline noise related problems disappear.*

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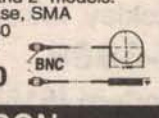

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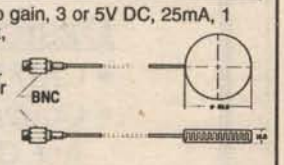

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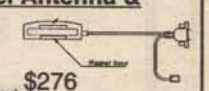

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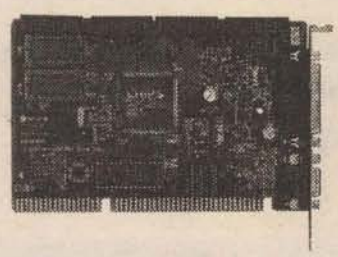

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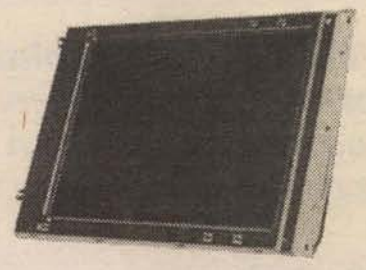

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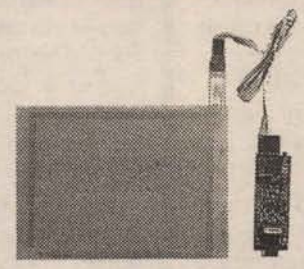

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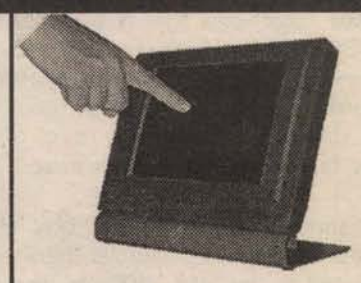

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by Jeff Stefan

Fuzzy Logic

This article explains how fuzzy logic works and provides you with a simple program so you can experiment with fuzzy logic systems of your own.

The Beginnings

Western thought is fundamentally based on Aristotelian logic and the "Law of the Excluded Middle." Either something is true or false, on or off, while everything in the middle is ignored.

According to the classical Western view of the universe, things aren't partially on or off, or partially true or false. Formal logic is based on this outlook.

This same view worked its way into abstract mathematics, beginning with set theory as invented and explored in the late 1800s by the mathematician George Cantor.

Although there's no formal definition of a set, the concept of sets is familiar to most of us. A set is a collection of objects. The only required property of a set object is membership; either something's in the set or it's not. One set all by itself isn't worth much, so how do multiple sets interact?

They interact via three fundamental set operations: Union, Intersection, and Complementation. See Figure 1 for a listing of fundamental set operations.

The Aristotelian viewpoint has propagated like a virus from logic to set theory, and mutated with the evolution of Boolean algebra. The names for intersection, union, and complementation change from set theory, formal logic, and Boolean logic, but the meaning is the same.

See Figure 2 for a list illustrating the names for the same operations in each of the domains, including fuzzy sets (the Fuzzy Logic operations will be explained later).

Boolean logic turned out to be a nearly perfect tool to describe switching and logic circuits. The digital computer is basically an Aristotelian logic device, and inherently Western in concept.

All this translates to information loss when describing the real world to a computer. What about the truths that reside in the excluded middle? We know from our everyday experience that the universe does not present itself in clear-cut, black and white, yes or no configurations. Many things are somewhat true or somewhat false. The universe presents you with the option of choosing some degree of truth or falsehood. How do we reflect these choices within a computer program?

Another big problem is the subjective nature of words. How do you map words and phrases into numbers? Phrases like "a little" or "a lot" are hard to quantify. How do you represent the weight of words in a computer program?

The problem of quantifying middle truths did not escape the thoughts of some prominent logicians throughout recent history. The Polish philosopher and logician Jan Lukasiewicz described a logical system in 1920 that consisted of three values: zero (false), one (true), and one-half (possible). Cornell professor Max Block described an early model of fuzzy sets in his 1937 paper entitled "Vagueness: An Exercise in Logical Analysis."

All of this work solidified in 1965 with the publication of Stanford Professor Lotfi Zadeh's paper entitled "Fuzzy Sets," in the June 1965 issue of the journal *Information and Control*. In an early pre-publication presentation of his paper, Zadeh was faced with severe criticism. This criticism dogged fuzzy logic for years, leading to a lack of research grants.

No one wanted to fund research for a risky, potential loser like fuzzy logic, and many claimed that fuzzy logic was just probability theory in disguise. If you can't get the money to study an emerging technology's properties and potential applications, then the new technology stalls and drifts to the unfunded, obscure backwaters of academia.

No one in the United States took fuzzy logic seriously, but things were different in Japan. Unburdened by the weight of Western Aristotelian Logic, the Japanese embraced fuzzy logic. Instead of arguing over the theoretical merits and faults of fuzzy logic, the Japanese produced fuzzy-based systems. Some of the Japanese fuzzy-based systems in production today are single button washing machines, subway and elevator controls, voice and handwriting recognition systems, and auto-focus cameras.

Basic Principles

There are three basic components to a fuzzy system: the fuzzifier, the rule base, and the de-fuzzifier, as shown in Figure 3.

Inputs enter the fuzzifier and are assigned a numerical value ranging from zero to one, depending on the input value's "degree of truth." Numbers themselves can be fuzzy. Say you're meeting someone for lunch at "around 12 o'clock." Fuzzy logic allows you to quantify vague situations like this.

We can assign truth values to "around 12 o'clock" as illustrated in Figure 4.

Truth values range from 0.0 to 1.0, with zero indicating "completely false" and one indicating "completely true." This part corresponds exactly to Boolean logic.

The excluded middle area is assigned numerical values. As the time values on the X axis approach 12:00 p.m., the truth values on the Y axis approach one. After 12:00 p.m., the truth values on the Y axis decrease.

By assigning a degree of truth value to time, we know that 11:45 a.m. has a truth value of 0.5, which tells us that 11:45 a.m. is "somewhat true" in terms of being close to our lunch date. As a rough guide to the meaning associated with truth values, see Figure 5. Just remember that the meanings associated to the truth values are arbitrary.

The linguistic meaning attached to the truth values are dependent on the system inputs you are

Fundamental Set Operations

Union	*- contains all of the objects in set A and set B*
Intersection	*- contains only the objects that are in set A and set B*
Complement	*- set of all objects not in a set*

Fig. 1

Set Theory	Formal Logic	Boolean Logic	Fuzzy Logic
Intersection	Conjunction	AND	Min(x,y)
Union	Disjunction	OR	Max(x,y)
Complementation	Negation	NOT	1.0 - x

Fig. 2

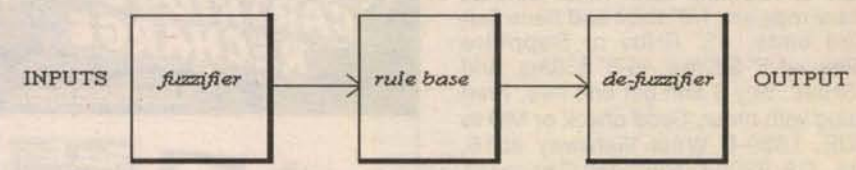

Fig. 3

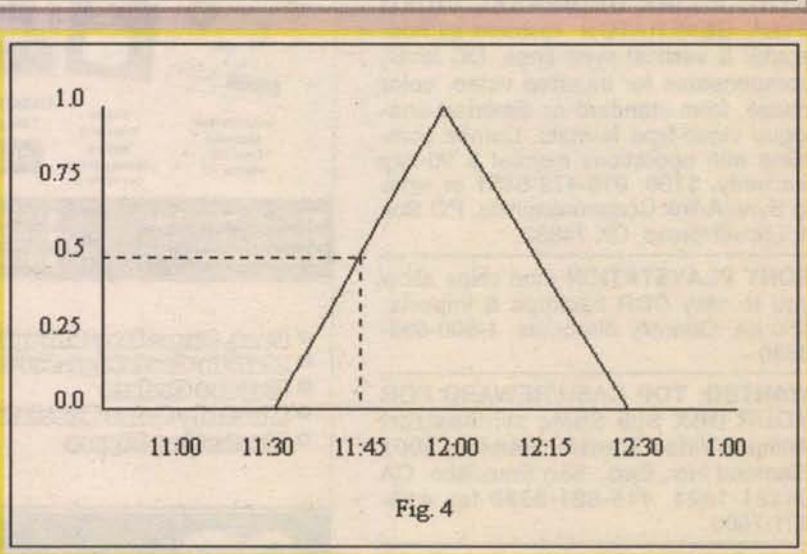

Fig. 4

fuzzifying. If you're looking at temperature, and if you consider 90 degrees F to be hot, then you could assign a truth value of .83, which is close to "mostly true."

Lost in Space

Let's say we're controlling a spacecraft re-entry vehicle, and we need to monitor velocity and heat shield temperature. If the heat shield gets too hot, then we have to change our angle of attack or else burn up. If we go in at too steep an angle, then we'll miss our landing coordinates. If we go too in at too shallow an angle, we'll skip off the atmosphere like a flat stone on water and spin off into the black regions of space. We intend to build a fuzzy control module that will keep the spacecraft within nominal limits.

The first thing we need to do is to assign degrees of truth values to the sensor input values, which are the temperature and re-entry angle of the spacecraft. These are called hedges. The graphs of these values are shown in Figure 6 and Figure 7. We have hedge values for both temperature and angle.

Once the input values are mapped to Y axis truth values, a rule base to manipulate the values must be established. We have eight rules in our system, which are listed in Figure 8.

These rules are of IF-THEN form, and are similar to rules found in expert systems, only they sound much more natural with the addition of the modifier "slightly." That's the beauty of Fuzzy Logic: we can use seemingly imprecise words like "slightly" or "somewhat," and assign them a precise numerical value.

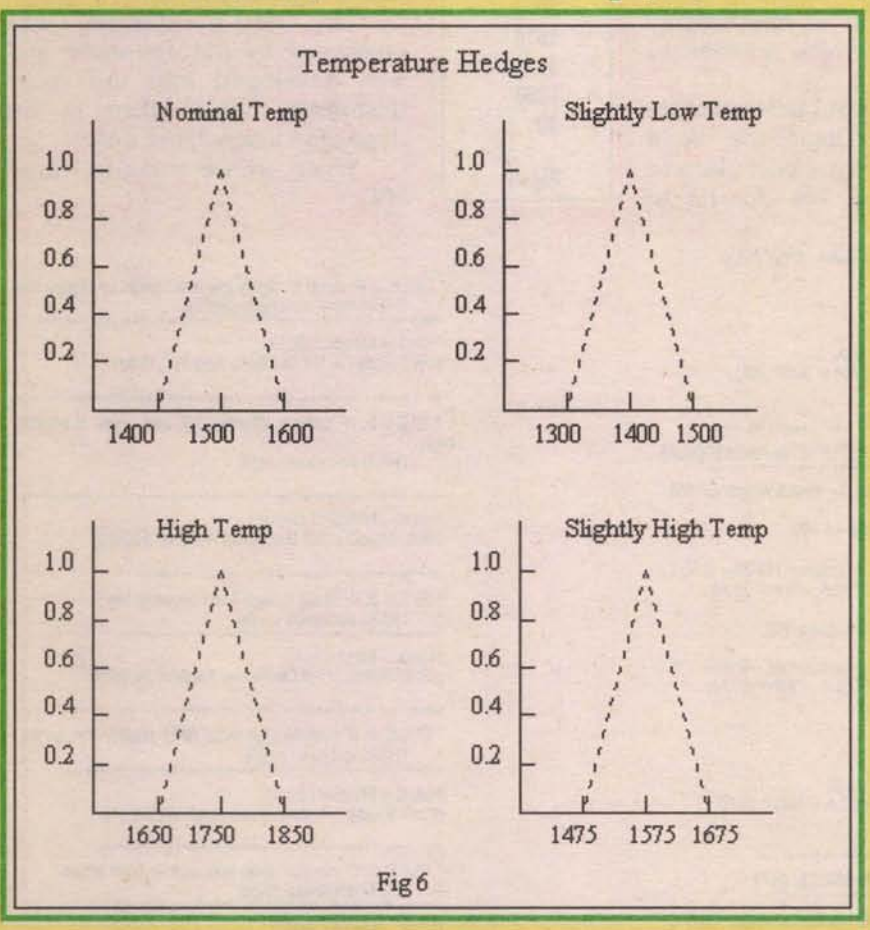

Fig 6

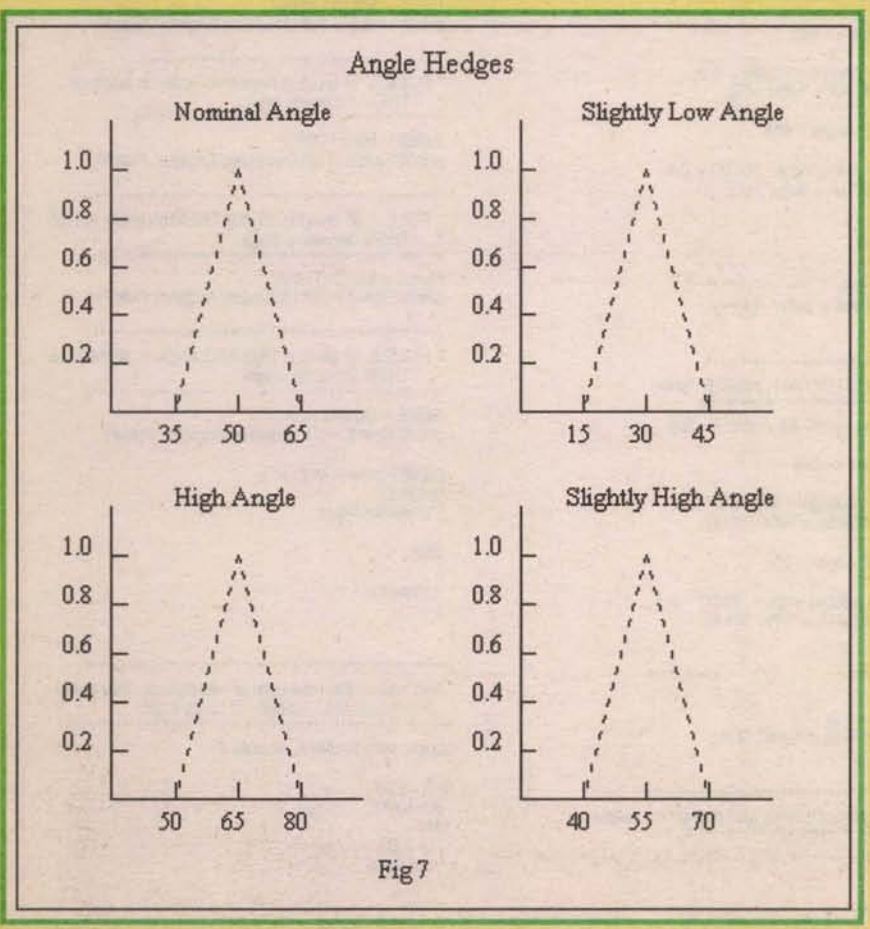

Fig 7

Determining a Range Function

We need two functions to fuzzify the incoming temperature and angle values. Here's one method: First, find the difference between the high and low value for the hedge. Looking at the Nominal Temp graph in Figure 6, the high value is 1600 and the low value is 1400. The difference is 200. We need a two-sided equation, since our hedge values rise on one side of the nominal value and fall on the other. The following is the pseudo-code instructions for the Nominal Temp graph:

```
IF Temp >= 1400 && Temp < 1600 THEN
 IF Temp <= 1500 THEN
   FuzzyTemp = (Temp - 1400)/200 + 0.5
ELSE IF Temp > 1500 THEN
 FuzzyTemp = fabs(Temp -1600)/200 + 0.5
ELSE
 FuzzyTemp = 0
```

If the temperature value is in the range we're looking for, and is less than or equal to the nominal temperature — 1500 — then subtract the lower limit from the temperature value and divide by the difference between the high and low values, which is 200. Add 0.5 to the result to scale it properly to the Y axis.

In order to get decreasing values for temperatures greater than the nominal value of 1500, subtract the temperature reading from the high value, and again divide by the range and add 0.5.

We need to take the absolute value of the result, since all we care about is the truth value and not its sign. This same method is used for all of the graphs for temperature and angle hedges. Again, this is just one of many ways to assign truth values. Assigning truth values is completely arbitrary, and the method used here makes sense for our system, but may not for another.

Coding the rule base is very easy. To AND two fuzzy numbers together, all we need to do is to find the smaller of the two numbers. Rule 1 is coded as:

```
Rule1 = Min(SLT,SLA);
```

where SLT stands for Slightly Low Temp and SLA stands for Slightly Low Angle. The Min function itself is simple:

```
double Min(double A, double B)
{
 if (A <= B)
 return(A);
      else
      if (A > B)
       return(B);
      }
```

We now have a rule base and our membership functions defined. What do we do with them? We read the inputs, run them through the fuzzification functions and the rules, then set an output to take some kind of action. In our case, we need to adjust the angle of the re-entry vehicle to avoid burning up. Here's where you, as the designer, must make some significant design choices.

You can de-fuzzify the outputs from the rule base and use the crisp value as a trigger for some control mechanism, or you can choose not to de-fuzzify the outputs.

In our example, the outputs from the rule base are printed and not de-fuzzified. In order to correct the angle of the re-entry vehicle in our system, take the highest numerical value produced by the rules and use that value as truth. A sample run for a temperature-angle pair is shown in Figure 9. The data

Truth Value	Meaning
0.0	Completely false
0.2	Mostly false
0.4	Somewhat false
0.6	Somewhat true
0.8	Mostly true
1.0	Completely true

Fig. 5

Rule Base

RULE 1: IF temp is slightly low AND angle is slightly low THEN increase angle.

RULE 2: IF temp is slightly high AND angle is slightly high THEN decrease angle

RULE 3: IF temp is high AND angle is high THEN decrease angle

RULE 4: IF temp is slightly high AND angle is slightly low THEN increase angle

RULE 5: IF temp is nominal AND angle is slightly high THEN decrease angle

RULE 6: If temp is high AND angle is nominal THEN decrease angle

RULE 7: IF temp is slightly low AND angle is high THEN decrease angle

RULE 8: IF temp is high AND angle is slightly low THEN increase angle

Fig. 8

file used with the program is called fval.dat and is listed in Figure 10.

Any data files you use for the program need to be in this format. The first value is the current temperature read from the sensors, and the second value is the re-entry angle. The program is named fuzz.exe, and the data file name in input from the command line. Just type: fuzz fval.dat to get the program to run.

In the trial run shown in Figure 9, the nominal angle (NA) value is 1.0, which is completely true. The temperature is high (HT) with a value of .95, so looking at the highest value in the rule base, it tells us via Rule 6 to decrease the re-entry angle. This is what we expect the rule base to tell us.

```
---------[READ INPUTS]----------
Temp = 1760.000000
Angle = 50.000000
---------[FUZZIFICATION]----------
NT = 0.000000
SLT = 0.000000
HT = 0.950000
SHT = 0.000000
NA = 1.000000
SLA = 0.000000
HA = 0.500000
SHA = 0.833333
---------[RULE BASE OUTPUT]----------
Rule1 = 0.000000 Increase Angle
Rule2 = 0.000000 Decrease Angle
Rule3 = 0.500000 Decrease Angle
Rule4 = 0.000000 Increase Angle
Rule5 = 0.000000 Decrease Angle
Rule6 = 0.950000 Decrease Angle
Rule7 = 0.000000 Decrease Angle
Rule8 = 0.000000 Increase Angle
```

Fig. 9

If you wanted just to look at one single value as the output of the rule base, then take all of the outputs and OR them together. In fuzzy logic, an OR operation means taking the maximum value of a set of numbers.

As usual, the code is yours to play with. I used Turbo C/C++ 3.0 for the example, but any C compiler should work equally as well. Adding an OR function to create a single output number from the set of rule outputs would be a nice addition to the code.

If you want to learn more about fuzzy logic, the World Wide Web is the best place to start. There are dozens of fuzzy resources on the Web so you can easily expand your personal knowledge base if your interest is serious.

It's strange how history repeats itself. In 1937, the same year that Max Block's published his early paper on fuzzy sets, Howard Hughes approached the US Army about a new, lightning quick plane he recently designed and built, the H-1.

FVAL.DAT

```
1450
30
1325
60
1475
50
1650
24
1760
50
1650
35
1800
20
```

Fig 10

The H-1 was highly maneuverable and flew in excess of 330 MPH — faster than any American airplane built. Just like Zadeh's notion of fuzzy sets, Hughes's H-1 was rejected by the Americans. Guess what happened?

The H-1's design was embraced by the Japanese and was developed into the most destructive fighter plane in the Japanese arsenal, the Zero.

When are we going to learn?

NV

```
/*****************************************************
* Filename: fuzz.c
* Description: Fuzzy Logic demo.
*
*
* (c) 1998 Jeff Stefan
*****************************************************/
#include <stdio.h>
#include <math.h>

double Min(double A, double B);
#define MAX_FILE_NAME 45

void main(int argc, char *argv[])
{
FILE *fp;
char Filename[MAX_FILE_NAME];
int Result;
double Temp,Angle;
double NT,SLT,HT,SHT,NA,SLA,HA,SHA;
d o u b l e
Rule1,Rule2,Rule3,Rule4,Rule5,Rule6,Rule7,Rule8;

 /*********************************
 * get filename from command line
 *********************************/
 if(argc < 2)
 {
  printf("Usage: fuzz filename\n");
  exit(0);
 }

 /***********
 * open file
 ***********/
 strcpy(Filename,argv[1]);
 fp = fopen(Filename,"r");
 if(fp == NULL)
 {
  printf("Can't open file\n");
  exit(0);
 }

 /*****************
 * init variables
 *****************/
 NT=SLT=HT=SHT=0.0;
 NA=SLA=HA=SHA=0.0;

 /*************************
 * read and process inputs
 *************************/
 do
 {
  printf("----------[READ INPUTS]----------\n");
  Result = fscanf(fp,"%lf",&Temp);
  if(Result == -1)
   break;
  printf("Temp = %lf\n",Temp);
  fscanf(fp,"%lf",&Angle);
  printf("Angle = %lf\n",Angle);

  printf("----------[FUZZIFICATION]----------\n");
  /*******************
  * NOMINAL TEMP (NT)
  *******************/
  if(Temp >= 1400 && Temp <= 1600)
  {
   if(Temp <= 1500)
   {
    NT = (Temp - 1400)/200 + 0.5;
    printf("NT = %lf\n",NT);
   }
   else if(Temp > 1500)
   {
    NT = fabs(Temp - 1600)/200 + 0.5;
    printf("NT = %lf\n",NT);
   }
  }
  else
  {
   NT = 0.0;
   printf("NT = %lf\n",NT);
  }

  /*************************
  * SLIGHTLY LOW TEMP (SLT)
  *************************/
  if(Temp >= 1300 && Temp <=1500)
  {
   if(Temp <= 1400)
   {
    SLT = (Temp - 1300)/200 + 0.5;
    printf("SLT = %lf\n",SLT);
   }
   else if(Temp > 1400)
   {
    SLT = fabs(Temp - 1500)/200 + 0.5;
    printf("SLT = %lf\n",SLT);
   }
  }
  else
  {
   SLT = 0.0;
   printf("SLT = %lf\n",SLT);
  }

  /****************
  * HIGH TEMP (HT)
  ****************/
  if(Temp >= 1650 && Temp <= 1850)
  {
   if(Temp <= 1750)
   {
    HT = (Temp - 1650)/200 + 0.5;
    printf("HT = %lf\n",HT);
   }
   else if(Temp > 1750)
   {
    HT = fabs(Temp - 1850)/200 + 0.5;
    printf("HT = %lf\n",HT);
   }
  }
  else
  {
   HT = 0.0;
   printf("HT = %lf\n",HT);
  }

  /*************************
  * SLIGHTLY HIGH TEMP (SHT)
  *************************/
  if(Temp >= 1475 && Temp <= 1675)
  {
   if(Temp <= 1575)
   {
    SHT = (Temp - 1475)/200 + 0.5;
    printf("SHT = %lf\n",SHT);
   }
   else if(Temp > 1575)
   {
    SHT = fabs(Temp - 1675)/200 + 0.5;
    printf("SHT = %lf\n",SHT);
   }
  }
  else
  {
   SHT = 0.0;
   printf("SHT = %lf\n",SHT);
  }

  /*******************
  * NOMINAL ANGLE (NA)
  *******************/
  if(Angle >= 35 && Angle <= 65)
  {
   if(Angle <= 50)
   {
    NA = (Angle - 35)/30 + 0.5;
    printf("NA = %lf\n",NA);
   }
   else if(Angle > 50)
   {
    NA = fabs(Angle - 65)/30 + 0.5;
    printf("NA = %lf\n",NA);
   }
  }
  else
  {
   NA = 0.0;
   printf("NA = %lf\n",NA);
  }

  /*************************
  * SLIGHTLY LOW ANGLE (SLA)
  *************************/
  if(Angle >= 15 && Angle <= 45)
  {
   if(Angle <= 30)
   {
    SLA = (Angle - 15)/30 + 0.5;
    printf("SLA = %lf\n",SLA);
   }
   else if(Angle > 30)
   {
    SLA = fabs(Angle - 45)/30 + 0.5;
    printf("SLA = %lf\n",SLA);
   }
  }
  else
  {
   SLA = 0.0;
   printf("SLA = %lf\n",SLA);
  }

  /*****************
  * HIGH ANGLE (HA)
  *****************/
  if(Angle >= 50 && Angle <= 80)
  {
   if(Angle <= 65)
   {
    HA = (Angle - 50)/30 + 0.5;
    printf("HA = %lf\n",HA);
   }
   else if(Angle > 65)
   {
    HA = fabs(Angle - 80)/30 + 0.5;
    printf("HA = %lf\n",HA);
   }
  }
  else
  {
   HA = 0.0;
   printf("HA = %lf\n",HA);
  }

  /*************************
  /* SLIGHTLY HIGH ANGLE (SHA)
  *************************/
  if(Angle >= 40 && Angle <= 70)
  {
   if(Angle <= 55)
   {
    SHA = (Angle - 40)/30 + 0.5;
    printf("SHA = %lf\n",SHA);
   }
   else if(Angle > 55)
   {
    SHA = fabs(Angle - 70)/30 + 0.5;
    printf("SHA = %lf\n",SHA);
   }
  }
  else
  {
   SHA = 0.0;
   printf("SHA = %lf\n",SHA);
  }

  /*****************************************
  * Run through rules and determine output
  *****************************************/
  printf("----------[RULE BASE OUTPUT]----------
\n");

  /*****************************************************
   * RULE 1: IF temp is slighly low AND angle is slightly low
   *     THEN increase angle slightly.
   *****************************************************/
   Rule1 = Min(SLT,SLA);
   printf("Rule1 = %lf Increase Angle\n",Rule1);

   /*****************************************************
    * RULE 2: IF temp is slightly high and angle is slightly
high
    *     THEN decrease angle.
   *****************************************************/
   Rule2 = Min(SHT,SHA);
   printf("Rule2 = %lf Decrease Angle\n",Rule2);

   /*****************************************
   * RULE 3: IF temp is high AND angle is high
   *     THEN decrease angle.
   *****************************************/
   Rule3 = Min(HT,HA);
   printf("Rule3 = %lf Decrease Angle\n",Rule3);

   /*****************************************************
   * RULE 4: IF slightly high temp AND slightly low angle
   *     THEN increase angle
   *****************************************************/
   Rule4 = Min(SHT,SLA);
   printf("Rule4 = %lf Increase Angle\n",Rule4);

   /*****************************************************
   * RULE 5: IF normal temp and slightly high angle
   *     THEN decrease angle
   *****************************************************/
   Rule5 = Min(NT,SHA);
   printf("Rule5 = %lf Decrease Angle\n",Rule5);

   /*****************************************
   * RULE 6: IF temp is high AND angle is nominal
   *     THEN decrease angle.
   *****************************************/
   Rule6 = Min(HT,NA);
   printf("Rule6 = %lf Decrease Angle\n",Rule6);

   /*****************************************************
   * RULE 7: IF temp is slightly low AND angle is high
   *     THEN decrease angle.
   *****************************************************/
   Rule7 = Min(SLT,HA);
   printf("Rule7 = %lf Decrease Angle\n",Rule7);

   /*****************************************************
   * RULE 8: IF temp is high AND angle is slightly low
   *     THEN increase angle.
   *****************************************************/
   Rule8 = Min(HT,SLA);
   printf("Rule8 = %lf Increase Angle\n",Rule8);

   printf("Press a key...\n");
   getchar();
  } while(!feof(fp));

  if(fp)
  {
   fclose(fp);
  }
}

/*****************************************************
* Min: return the minimum of two values. This is the
*   traditional AND function in fuzzy logic.
*****************************************************/
double Min(double A, double B)
{
 if(A <= B)
  return(A);
 else
  if(A > B)
   return(B);
}
```

DEALER DIRECTORY

The dealers listed below carry the latest issue of Nuts & Volts, for your convenience.

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Denver 80220

International Tesla Society
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216 Commerce Dr., Unit 2
Fort Collins 80524

Tower Records/Video
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Denver 80206

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530 Compton #C
Broomfield 80020

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1660 Whitney Ave.
Hamden 06517

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Newark 19711

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Fort Lauderdale 33301

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Fort Lauderdale 33309

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2245 W. Fairbanks
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8260 Sunset Strip
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220 W. Harry St.
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Lakeside News
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Metairie 70002

Tower Records
408 N. Peter St.
New Orleans 70130

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2014-A Industrial Dr.
Annapolis 21401

Tower Records/Video
2566 Solomons Island Rd.
Annapolis 21401

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244 Essex St.
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579 G.A.R. Hwy. Rt. 6
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Family Electronics
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Radio City, Inc.
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123 S. Main St.
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Events

CALENDAR

The Events Calendar is a free service limited to electronic events such as computer shows, hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days prior to the event. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:
Nuts & Volts Magazine
Events Calendar
430 Princeland Court
Corona, CA 91719
Phone 909-371-8497
Fax 909-371-3052
E-mail events@nutsvolts.com

APRIL 1998

APRIL 3-4

AL - ALBERTVILLE - Hamfest. Albertville Recreation Center. Fri: 5-9pm, Sat: 8am-3pm. Buddy Smith KC4URL, 205-593-2516. E-Mail: kc4url@airnet.net
AR - SHERWOOD - Central AR Radio Emergency Net Hamfest. J. C. Smith N5RXS, 501-568-7982
GA - ATLANTA - Southeastern VHF Conference. Sandy Donahue W4RU, 404-875-9450. E-Mail: w4ru@arrl.org

APRIL 3-4-5

GA - AUGUSTA - Annual Worldwide Break. Radisson Hotel & Conference Ctr. Two 10th St. Sam Hacker 706-790-6213
MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

APRIL 4

CA - ARMONA - Hams & Hackers Swap Meet. Hanford Fraternal Hall, 10th Ave. at Florinda, Rick WB6VFZ, 209-945-2266
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CO - BOULDER - Longmont ARC Hamfest. Jim Walker, E-Mail: walker.jim@usa.net
CT - WATERFORD - Ham Radio Auction. Waterford Senior Center on Rte. 85. Tony Griggs AA1JN, 860-859-0162. Web: www.ims.uconn.edu/~rason
FL - FT. LAUDERDALE - Computer Show. Holiday Inn West. 5100 N. St. Rd. 7. Narisaam Computer Show 770-663-0983
MI - LIVONIA - Super Computer Sales. Livonia Elks Lodge Hall, 31117 Plymouth Rd. 10am-3pm. Computers And You 734-283-1754
NC - MORGANTON - Catawba Valley Hamfest and Computer Fair. Burke Co. Fairgrounds Hwy. 181N. Thomas Taylor KC4QPR. 704-433-6205. E-Mail: kc4qpr@vistatech.net
NH - TWIN MOUNTAIN - Hamfest & Computer Fair. Twin Mountain Town Hall. 8am-3pm. Richard Force WB1ASL, 603-788-4428 bhabooks@together.net
OH - BEREA - Computer Show. Cuyahoga Co. Fairgrounds. 10am-3pm. Peter Trapp Shows. 603-272-5008. www.petertrapp.com
PA - FREDERICKSBURG - Appalachian AR Group Hamfest. Paul Felty WB3HEC. 717-566-2606
VA - GOOCHLAND - SMART Fest. VA Co. Fairgrounds. 8am-3pm. Buddy Travis KA4NNN, 540-894-0406. E-Mail: btravis@mnsinc.com
WA - SPOKANE - Lilac City ARC Hamfest. St. Anns Parish Hall, E. 2120 First Ave. 9am-5pm. 509-327-7196
WA - VANCOUVER - Clark Co. ARC Hamfest. Luther Brisky KC7KVL, 360-896-8909. E-Mail: lwayne@worldaccessnet.com Web: http://www.w7aia.org

APRIL 4-5

CA - VALLEJO - Computer Show. Solano Co. Fgrds. MarketPro 415-456-6730 Web: http://marketpro.com
FL - FT. LAUDERDALE - Computer Show. War Memorial Auditorium. 9:30am-4pm. MarketPro 301-984-0880
GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827
MD - PIKESVILLE - Computer Show. Pikesville Armory. 9:30am-4pm. MarketPro 301-984-0880
OH - COLUMBUS - Computer Show. OH Expo Center. 9:30am-4pm. MarketPro 301-984-0880
PA - KING OF PRUSSIA - Computer Show. Valley Forge Conv. Ctr. 9:30am-4pm. MarketPro 301-984-0880

APRIL 5

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
CA - OXNARD - Computer Show. Community Ctr. MarketPro 415-456-6730 Web: http://marketpro.com
FL - PALM BEACH GARDENS - Computer Show. Palm Beach Gardens Marriott. 4000 RCA Blvd. Narisaam Computer Show 770-663-0983
IA - DELOIT - Denison Repeater Assn. Hamfest. John Amdor KD6MXL. 712-748-8162. E-Mail: johnmxl@netins.net Web: http://www.netins.net/showcase/johnmxl/deloit98.html
MA - TAUNTON - Computer Show. Holiday Inn. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
MI - GRAND RAPIDS - Super Computer Sales. Crowne Plaza, 5700 28th St. S.E. 10am-4pm. Computers And You 734-283-1754
NC - RALEIGH - Hamfest. NC State ARRL Convention & Computer Fair. Jim Graham Bldg., State Fairgrounds. 8am-4pm. Wilbur Goss WD4RDT, 919-266-7883
NJ - TRENTON - Delaware Valley Radio Assn. Hamfest. Tall Cedars of Lebanon picnic grove, Sawmill Rd. Darryl Foyuth N2JVP, 609-882-2240. Web: www.slac.com/w2zq
OH - AKRON - Computer Show. Tadmor Shrine Temple. 10am-3pm. Peter Trapp Shows. 603-272-5008. www.petertrapp.com
VA - VIRGINIA BEACH - Computer Show. VA Beach Pavilion. 9:30am-4pm. MarketPro 301-984-0880
WI - MIDDLETON - Madison Area Repeater Assn. Swapfest. John Q. Hammons Trade Center. Jeremy Charles N9VHT. 608-245-8890 http://www.cs.wisc.edu/~jeremyc/mara/swapfest

APRIL 10-11

MS - TUPELO - Tupelo, Booneville and Union Co. ARCs Hamfest. Jack Ellis KI5QV, 601-842-7255. Web: http://www.tupelofest.org

APRIL 11

AR - BENTONVILLE - Benton County Radio Operators. BCRO, P.O. Box 883, Pea Ridge, 72751
CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CA - SAN DIEGO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730. Web: http://marketpro.com
CA - SANTA ROSA - Computer Show. Sonoma Co. Fgrds. MarketPro 415-456-6730. Web: http://marketpro.com
FL - JACKSONVILLE - Computer Show. Morocco Shrine Auditorium. 9:30am-4pm. MarketPro 301-984-0880
FL - MIAMI - HamSwapfest. U. of Miami Coral Gables Campus, Physics Parking Lot. 8am-12pm. Walt W4DWN 305-895-0398
MI - FLINT - Super Computer Sales. IMA Arena, 3501 Lapeer Rd. 10am-3pm. Computers And You 734-283-1754
OK - LAWTON - Lawton Ft. Sill ARC Hamfest. Bob Morford KA5YED, 580-355-6120. E-Mail: w5ks@rli.net
OR - PENDLETON - Hamfest & Computer Fair. Conv. Center. 8am-4pm. Denton WB7TDG, 541-276-8319. E-Mail: denton@oregontrail.net
PA - ALLENTOWN - Computer Show. Allentown Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
PA - HARRISBURG - Computer Show. Farm Show Complex. 9:30am-4pm. MarketPro 301-984-0880
PA - MONROEVILLE - Computer Show. Pittsburgh Expo Mart. 9:30am-4pm. MarketPro 301-984-0880
TN - CLINTON - Oak Ridge ARC Hamfest. Jim Whittlesey KC4RHW. E-Mail: kc4rhw@bellsouth.net
VA - CHANTILLY - Computer Show. Capital Expo Center. 9:30am-4pm. MarketPro 301-984-0880

APRIL 17-18-19

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

APRIL 18

AZ - PHOENIX - ARC Hamfest. George Cooney KQ7C, 602-274-6212. E-Mail: georgie@aztec.asu.edu
CA - SACRAMENTO - River City ARC Hamfest. Roy Rudebaugh KD6LLE, 916-427-6852. E-Mail: kd6lle2@juno.com
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
GA - WARNER ROBINS - Central Georgia ARC Hamfest. Dennis Ryckman KF4LTH, 912-956-1665
ME - AUGUSTA - Computer Show. Civic Center. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
MI - DEARBORN - Super Computer Sales. Dearborn Civic Center, 15801 Michigan Ave. 10am-3pm. Computers And You 734-283-1754
MN - FERGUS FALLS - Lake Region ARC Hamfest. William Morgan AA0AX, 218-736-4448
MO - JOPLIN - ARC Hamfest. Andy Gabbert KA0TUD, 417-673-8371. E-Mail: agabbertka0tud@hotmail.com
PA - JOHNSTOWN - Computer Show. War Memorial Arena. 9:30am-4pm. MarketPro 301-984-0880
PA - LEBANON - Computer Show. Lebanon Valley Expo Center. 9:30am-4pm. MarketPro 301-984-0880
TN - DAYTON - Rhea County ARS Hamfest. Tom Mize 423-570-0840. Web: http://www.volstate.net/~ko4sy
TX - BELTON - Spring Fest. Bell County Expo Center. Mike Lefan WA5EQQ, 254-773-3590. E-Mail: hamexpo@vvm.com Web: http://www.tarc.org

APRIL 18-19

AL - BIRMINGHAM - Southeastern Div. Conv. Bill Levey WA4FAT, 205-97-0622. E-Mail: barc@bro.net Web: http://bro.net/barc
CA - SACRAMENTO - Computer Show. Cal Expo. MarketPro 415-456-6730 Web: http://marketpro.com
CT - HARTFORD - Trinity College Fire Fighting Home Robot Contest. 12pm-5pm. www.trincoll.edu/~robot JMENDEL141@AOL.COM
FL - TAMPA - Computer Show. FL State Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
IL - ELGIN - CoCofest. Holiday Inn, Holidome Indoor Recreation Ctr. Sat: 10am-5pm, Sun: 10am-3:30pm. Tony Podraza 847-428-3576. TONYPODRAZA@JUNO.COM
MD - GAITHERSBURG - Computer Show. Montgomery Co. Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
OH - CINCINNATI - Computer Show. Cincinnati Gardens. 9:30am-4pm. MarketPro 301-984-0880
TN - EAST RIDGE - Computer Show. Camp Jordan Arena. 9:30am-4pm. MarketPro 301-984-0880
VA - NORFOLK - Computer Show. Norfolk Scope. 9:30am-4pm. MarketPro 301-984-0880

APRIL 19

CA - LANCASTER - Computer Show. Antelope Valley Fgrds. MarketPro 415-456-6730. Web: http://marketpro.com
DE - NEWARK - Computer Show. University of Delaware. 9:30am-4pm. MarketPro 301-984-0880
IL - STICKNEY - Ham and computer show. Hawthorne Race Course, 3500 S. Cicero Ave. 8am-2pm. DARC, 7511 Walnut Ave., Woodridge, IL 60517-2818. http://homepage.interaccess.com/~geirh/
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776. Web: http://web.mit.edu/w1mx/www/swapfest.html
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
MI - MADISON HEIGHTS - Super Computer Sales. UFCW Hall, 876 Horace Brown Dr. 10am-4pm. Computers And You 734-283-1754
MI - ST. JOSEPH - Blossomland ARA Hamfest. Duane Durflinger 616-982-0404. E-Mail: comdac@comdac.com Web: http://www.comdac.com/bara/
MN - SHAKOPEE - Hobby electronics show. Canterbury Park. 12pm-5pm. Helen WB0HOX, 612-361-6782
MO - CEDAR HILL - Jefferson County ARC Hamfest. Jim Autery KA0WXN, 314-296-3473
PA - STATE COLLEGE - Computer Show. Penn State Conference Ctr. Hotel. 9:30am-4pm. MarketPro 301-984-0880

APRIL 24-25

AR - LITTLE ROCK - Hamfest. The Expo Center, Interstate 30. Fri: 4pm-9pm, Sat: 8am-5pm. Jim Blackmon KB5IFV, 870-246-6734. E-Mail: 1rhamfest@usa.net Web: http://www.aristotle.net/~n5xay/lrh98.html
FL - GAINESVILLE - Hamfest & Computer Show. Alachua County Fairgrounds. Larry Walker WB4VAU, 352-377-0683

APRIL 25

CA - FRESNO - Computer Show. Fresno Fgrds. MarketPro 415-456-6730 Web: http://marketpro.com
CA - SONOMA - Hamfest. Sonoma Valley Veteran's Memorial Bldg., 126 1st St. W. 8am-noon. Darrel WD6BOR, 707-996-4494.
IA - DES MOINES - RAA Hamfest. Ron Hobbs N0XWI, 515-255-4020. E-Mail: rwhobbs@aol.com
MD - NEW CARROLLTON - Computer Show. Ramada Conference & Exhibition Ctr. 9:30am-4pm. MarketPro 301-984-0880
MI - TAYLOR - Super Computer Sales. Democratic Club Hall, 23400 Wick Rd. 10am-3pm. Computers And You 734-283-1754
MN - ROCHESTER - ARC Hamfest. John Scott N0HZN, 507-285-6522. E-Mail: n0hzn@aol.com Web: http://members.aol.com/rarchams
NH - DURHAM - Computer Show. Whittemore Arena @ UNH. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
NJ - HARMONY TOWNSHIP - Cherryville Repeater Assn. Hamfest. Marty Grozinski W2CG, 908-788-2644, 908-788-4080
NM - ALBUQUERQUE - ARC & AR Caravan Club Hamfest. Chuck Opdyke KC5GA, 505-858-0306
NY - SYRACUSE - Liverpool ARC Hamfest. Robert Hamby W2WRH, 315-622-1068
OR - KLAMATH FALLS - Keno ARC Hamfest. Tom Hamilton WD6EAW. 541-883-2736. E-Mail: wjonesjr@cdsnet.net Web: http://home.cdsnet.net/~wjonesjr/kenoarc.htm
PA - BLOOMSBURG - Columbia-Montour ARC Hamfest & Computer Show. Bloomsburg Fairgrounds. Dave Schack WC3A. 717-752-6851. E-Mail: kev17815@epix.net Web: www.bafn.org/~cmarc/
PA - LANCASTER - Computer Show. Lancaster Host Resort. 9:30am-4pm. MarketPro 301-984-0880
RI - WEST GREENWICH - WA County & Fidelity ARC Hamfest. Everett Lovenbury N1VEZ, 401-539-1107. E-Mail: N1VEZ@juno.com
VA - RICHMOND - Computer Show. The Showplace. 9:30am-4pm. MarketPro 301-984-0880

APRIL 25-26

FL - ORLANDO - Computer Show. Central FL Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
IN - INDIANAPOLIS - Computer Show. IN State Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
OH - DAYTON - Computer Show. Montgomery Co. Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
TX - CHICOTA - Red River Valley ARC Hamfest. Don Honsinger KB5MUS, 903-732-3290. E-Mail: ka5bhy@webwide.net Web: http://pjc.paris.cc.tx.us.80/org/arrvarc

APRIL 26

CA - SACRAMENTO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730. Web: http://marketpro.com
DE - NEW CASTLE - State Conv. Nur Temple, Rte. 13 N. 9am-3pm. Hal Frantz KA3TWG, 302-793-1080. E-Mail: hfrantz@magpage.com Web: http://www.magpage.com/penndel
IL - ARTHUR - Moultrie ARK Hamfest. Moultrie/Douglas County Fairgrounds. 8am-1pm. Ralph Zancha WC9V, 217-873-5287 or 217-543-2178
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
IL - KEWANEE - Area Amateur Radio Operators. Bill Anderson WB9TEW, 309-932-3023. E-Mail: bill@inw.net
MA - WORCESTER - Computer Show. Centrum Centre. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net

Continued on page 95

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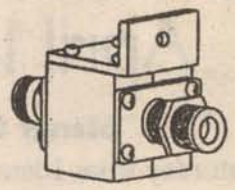

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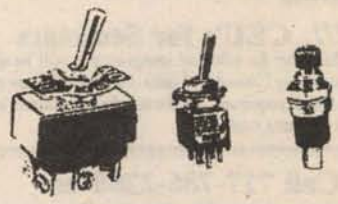

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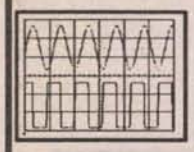

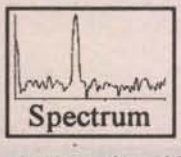

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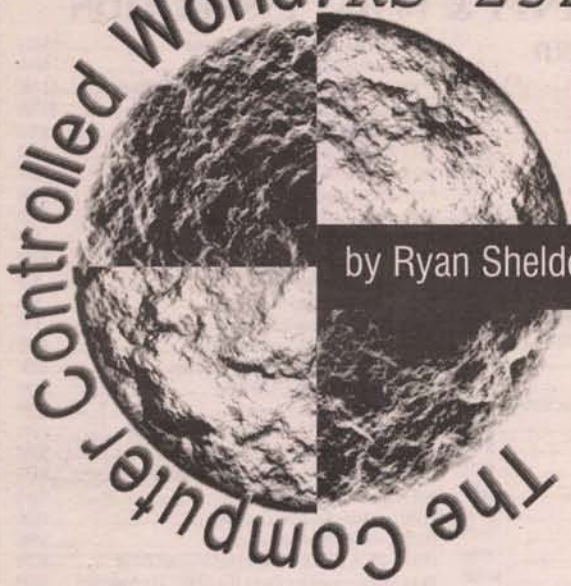


CHARACTER LCD NETWORKABILITY

by Ryan Sheldon, National Control Devices (404) 244-2432 http://members.aol.com/ncdcat

Character LCD displays have become an integral part of many projects for the hobbyist and professional engineer. RS-232 character display controllers are now commonplace in many applications. While most commercially available controllers are easy to use, few allow you to control more than a single display from a single serial port.

A few years ago, I came up with an inexpensive way to control up to 16 character LCD displays of any size using only two wires from the RS-232 port of my computer. For about $15.00 per controller, this solution is by far the cheapest and most versatile.

The LCD display controllers in this article support modular RS-232 networking. Modular networking allows you to control up to 16 different devices in any combination from a single RS-232 serial port.

In the Dec. '97 issue, you learned how to build a simple relay controller that supports modular RS-232 networking ("RS-232 Relays"). In March '98, you learned how to read data into the computer using a modular input scanner ("Opening Windows to the World").

You can use a single serial port to control the relay driver you built in December, and the Input Scanner you built in March to the LCD display controller you build this month.

Future articles will explain how to add graphic LCD display modules, video character overlays, video matrix switchers, and a variety of motor controllers to this network. So you can quickly see that modular networking is extremely powerful.

Using a modular programming structure enables complete control over a device with a single line of code, making the network easy to control for even an entry-level programmer.

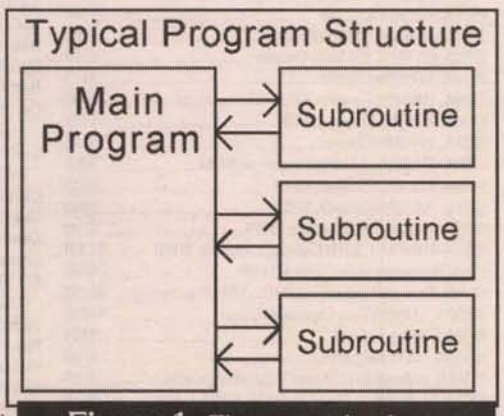


Figure 1. The example above shows a typical program structure where a main program is used to call subroutines. After the subroutine has executed, control is returned to the main program.

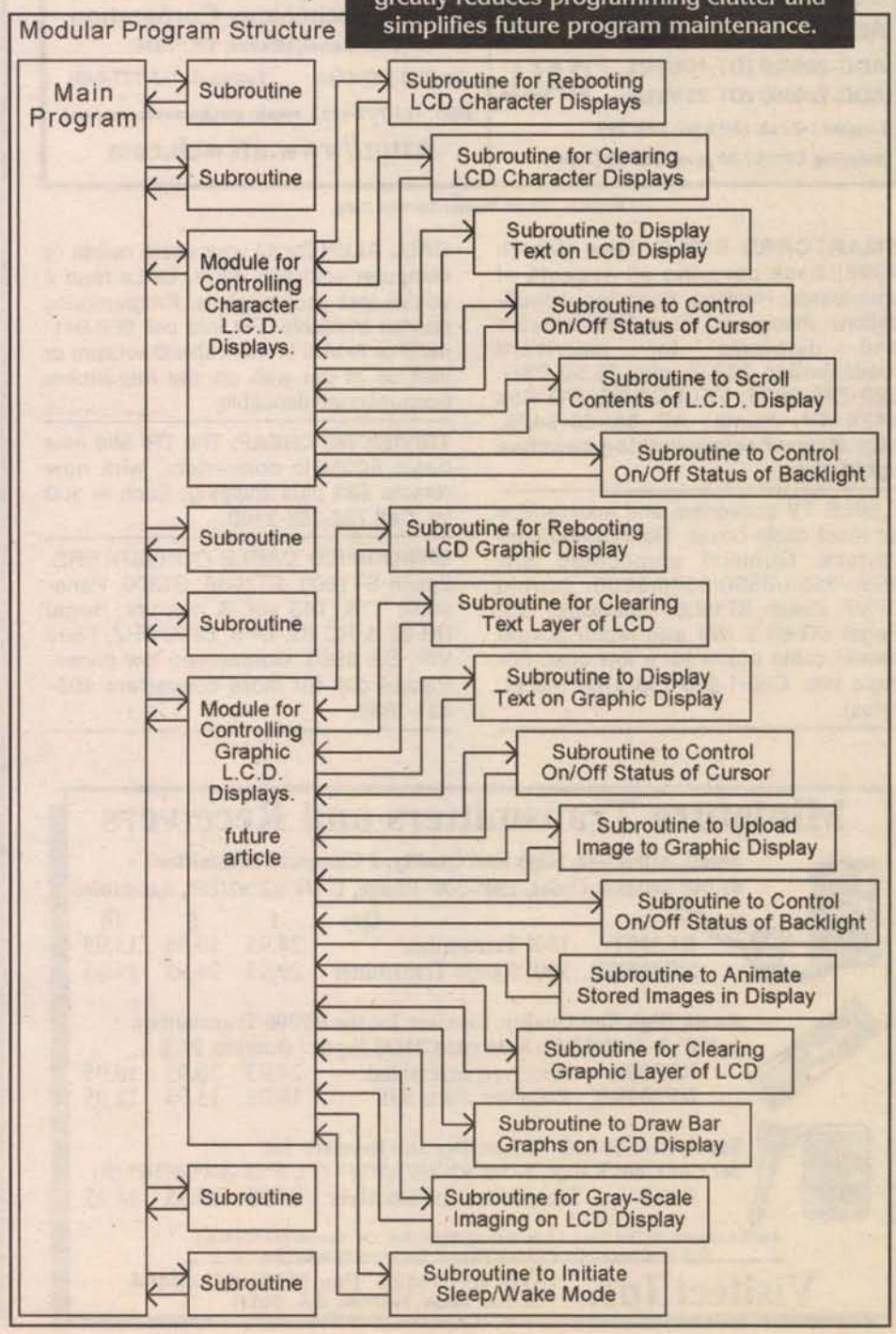
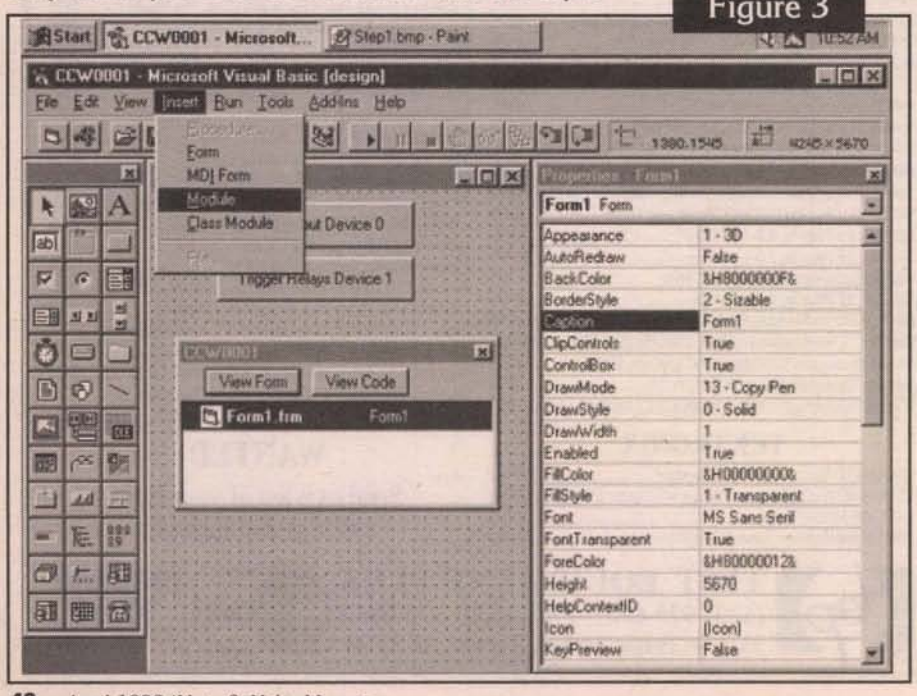


Figure 2. The example above shows a typical program containing two modules. The first module allows you to control character LCD displays while the second allows you to control graphic LCD displays. Modules contain their OWN set of subroutines. This greatly reduces programming clutter and simplifies future program maintenance.

Figure 3



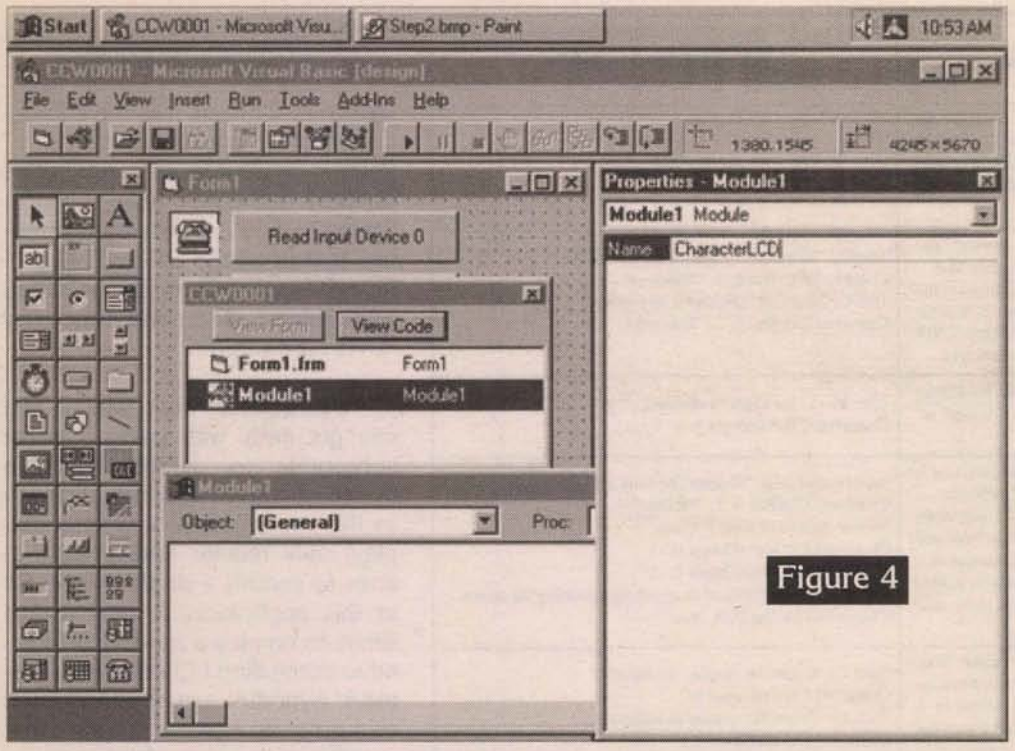


Figure 4

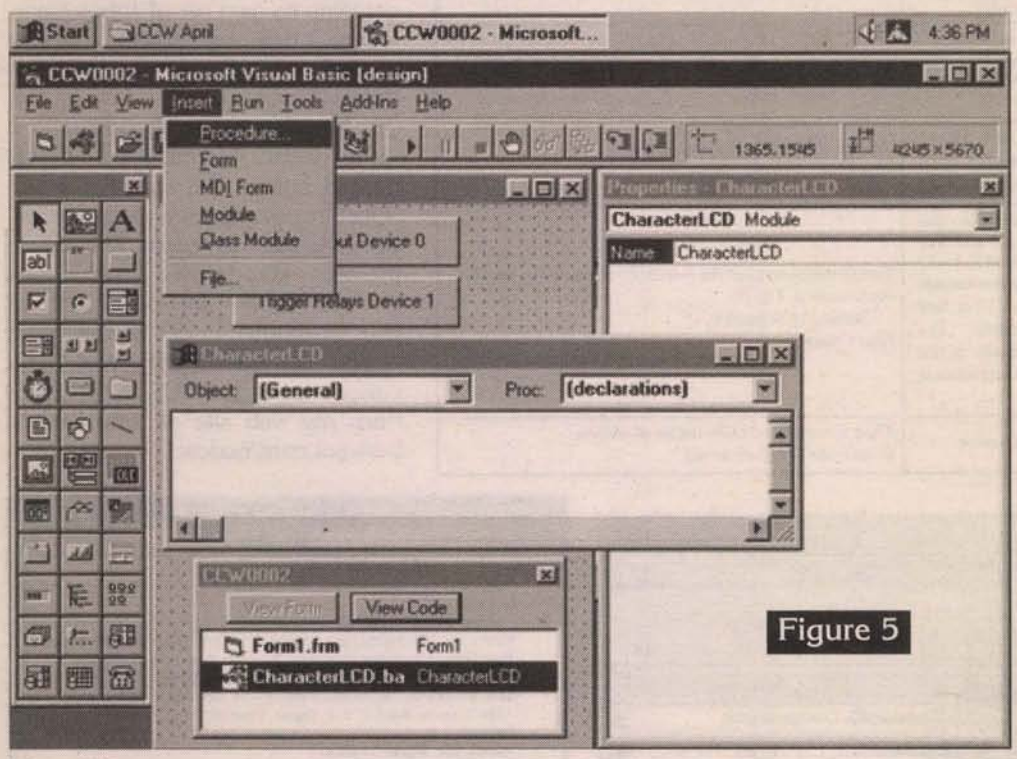


Figure 5

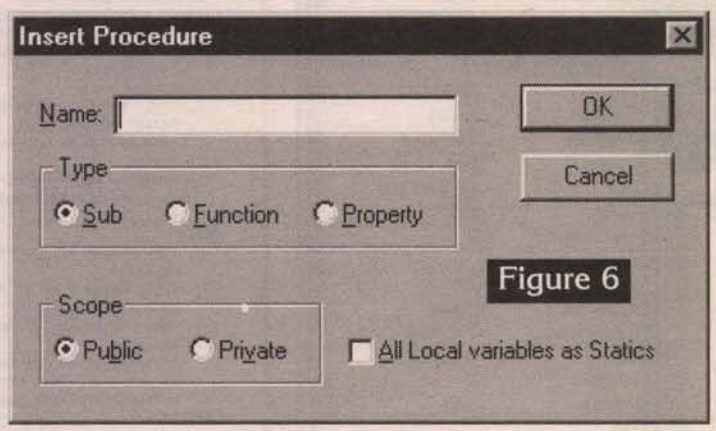


Figure 6

Pin#	Name	I/O	Function
1	Vss	--	Ground
2	Vdd	-	+5 Vdc
3	Vlc	-	Contrast Adjustment
4	RS	Input	Register Select 0 - Instruction 1 - Data
5	R/W	Input	Read/Write to Display 0 - Write to Display 1 - Read from Display (not used)
6	E	Input	Command/Data Strobe
7	DB0	I/O	Data Bit 0 (not used)
8	DB1	I/O	Data Bit 1 (not used)
9	DB2	I/O	Data Bit 2 (not used)
10	DB3	I/O	Data Bit 3 (not used)
11	DB4	I/O	Data Bit 4
12	DB5	I/O	Data Bit 5
13	DB6	I/O	Data Bit 6
14	DB7	I/O	Data Bit 7

Table 1

Possible Applications

Let's say for a moment that you wanted to build a computer-controlled security system for your house. The modular RS-232 network allows you to ask the input scanner if an intruder has been detected with a SINGLE line of code (a subroutine call). If an intruder was detected, you could use another line of code to activate a relay that sounds an alarm.

And now you can use a couple more lines of code to write a simple message on a display that tells your family that an intruder was detected. If you're like me, you might even add a line of code to the program to tell the relay driver to lock the intruder in a room.

All of these things are easily accomplished using RS-232 modular networking. Some of my readers are actively developing a security system very similar to the one described above. In addition, they are also using other components of this modular network to switch video and audio, turn on or off time-lapse video recorders, and make detailed log entries of traffic flow throughout secure buildings.

Modular RS-232 networking is perhaps the most powerful type of network available for three simple reasons: 1) Users can choose the building blocks for their specific computer control application. 2) Modular hardware that supports this communications protocol is very inexpensive and is readily available at the board or chip level. 3) Modular networkability makes use of your existing RS-

Figure 7

Module: CharacterLCD.BAS

Each subroutine in this module is responible for controlling a specific function on an LCD character display. Up to 16 LCD character displays of various sizes can be attached to a single RS-232 serial port using only two wires.

This module has been used with character LCD displays of various sizes from 16x1 to 20x4 and should be compatible with any character display up to 40x4.

Provisions have been included in this module for software control of an EL or LED backlight.

In addition, this module is compatible with displays made by EPSON, Optrex, Hitachi, AND, and many other manufacturers.

```
CharacterLCD
Object: (General)  Proc: Text
Sub Text(Device, lin, TXT$)
    'Set the cursor on the user-selected
    'line of the display
    If lin = 1 Then Line1 Device
    If lin = 2 Then Line2 Device
    If lin = 3 Then Line3 Device
    If lin = 4 Then Line4 Device

    If TXT$ <> "" Then
        'count from 1 to the length of characters
        'held in TXT$
        For n = 1 To Len(TXT$)
            'Convert String into ASCII code
            SEND = Asc(Mid$(TXT$, n, 1))
            'Split and Send ASCII value to the display
            'Part1
            WriteData Device, ((SEND And 240) / 16) + 16
            'Part 2
            WriteData Device, ((SEND And 15)) + 16
        Next n
    End If

End Sub
```

```
CharacterLCD
Object: (General)  Proc: WriteData
Sub WriteData(Device, Dat)
    'Compute the Device Number
    Dev = Device * 16
    'Crop out first half of incoming Dat
    A = Dat And 15
    'Crop out second half of incoming Dat
    B = (Dat And 240) / 16
    'Transmit first half
    Form1.MSComm1.Output = Chr$(A + 0 + Dev)
    'Transmit second half with strobe (2)
    Form1.MSComm1.Output = Chr$(B + 2 + Dev)
    'Note: Display controlled in 4-bit mode
End Sub
```

```
CharacterLCD
Object: (General)  Proc: SetLine
Sub SetLine(Device, Lin)
    'Position Cursor on Line 1
    If Lin = 1 Then
        WriteData Device, 14
        WriteData Device, 12
    End If
    'Position Cursor on Line 2
    If Lin = 2 Then
        WriteData Device, 10
        WriteData Device, 12
    End If
    'Position Cursor on Line 3
    If Lin = 3 Then
        WriteData Device, 9
        WriteData Device, 4
    End If
    'Position Cursor on Line 4
    If Lin = 4 Then
        WriteData Device, 13
        WriteData Device, 4
    End If
End Sub
```

```
CharacterLCD
Object: (General)  Proc: Backlight
Public Sub Backlight(Device, Status)
    'If Status = 0 then turn off backlight
    If Status = 0 Then
    'Turn Off Backlight
        WriteData Device, 0
        WriteData Device, 8
    Else
        'Otherwise, Turn On Backlight
        WriteData Device, 0
        WriteData Device, 4
    End If
End Sub
```

```
CharacterLCD
Object: (General)  Proc: RebootDisplay
Sub RebootDisplay(Device)
    'Compute a Device Number
    Dev = Device * 16
    'Send Reboot Instructions 3 times to
    'ensure reboot
    For Count = 1 To 3
        'Reset Buffer
        Form1.MSComm1.Output = Chr$(Dev + 0)
        Form1.MSComm1.Output = Chr$(Dev + 0)
        'Send Init Codes
        WriteData Device, 0
        WriteData Device, 2
        WriteData Device, 0
        WriteData Device, 3
    Next Count
```

```
CharacterLCD
Object: (General)  Proc: MoveCursor
Public Sub MoveCursor(Device, Direction)
    'If Direction = -1 then Move Left
    If Direction = -1 Then
        'Move Cursor to the Left
        WriteData Device, 1
        WriteData Device, 1
    End If
    'If Direction = 1 then Move Right
    If Direction = 1 Then
        'Move Cursor to the Right
        WriteData Device, 1
        WriteData Device, 5
    End If
End Sub
```

```
CharacterLCD
Object: (General)  Proc: Scroll
Public Sub Scroll(Device, Direction)
    'If Direction Is -1 Left then Scroll Left
    If Direction = -1 Then
        'Scroll Contents of the Display Left
        WriteData Device, 1
        WriteData Device, 11
    End If
    'If Direction Is 1 Right then Scroll Right
    If Direction = 1 Then
        'Scroll Display Contents to the Right
        WriteData Device, 1
        WriteData Device, 12
    End If
End Sub
```

```
CharacterLCD
Object: (General)  Proc: SetCursor
Public Sub SetCursor(Device, Status)
    'If Status = 0 then Turn Off Cursor
    If Status = 0 Then
        'Send Command to Turn Off Cursor
        WriteData Device, 0
        WriteData Device, 12
    End If
    If Status = 1 Then
        'Send Command to Turn On Cursor
        WriteData Device, 0
        WriteData Device, 13
    End If
    If Status = 2 Then
        'Send Command to Turn On Underscore
        WriteData Device, 0
        WriteData Device, 14
    End If
End Sub
```

```
CharacterLCD
Object: (General)  Proc: ClearScreen
Sub ClearScreen(Device)
    'Send Commands to Clear the Screen
    WriteData Device, 0
    WriteData Device, 1
End Sub
```

232 serial port eliminating the need for expensive add-in cards.

Software

A modular RS-232 network requires the use of software that is just as modular as the hardware ... that is, software that holds control routines for your specific computer control application. The modular network makes use of subroutines and modules for all control functions.

I have already spent several hundred hours developing subroutines that work for the various devices. So my primary objective is to provide you with the information you require to use the subroutines I have already written. Again, I will focus on controlling these displays using Visual Basic 4 Professional under Windows 95. If you are not a VB programmer, you should find the code easily adaptable to your native language.

The subroutines I have already written are, what I call, control routines. Control routines serve as "ready-made" bridges between the programmer and a real-world control device. These bridges are perhaps the most powerful tool for the programmer because they completely eliminate the complexities of speaking to hardware. And for the non-programmer, control routines make the logical steps of computer control much easier to understand.

For our purposes here, a control routine tells external hardware what to do. It may tell a relay to turn on, read the status of an input, or display a line of text on this month's character LCD display. But keep in mind, these control routines were designed to eliminate programming. To simplify the programming aspect of this project, two types of control routines will be used: subroutines and modules.

Subroutines are the most common type of control routine. In last month's issue, we discussed the usage of subroutines. In summary, it was the responsibility of the subroutine to perform the actual data transmission to control an individual device. The main program contained a set of buttons that could be clicked. When activated, the buttons would tell a subroutine to turn off a relay or maybe read an input. The actual lines of code within the subroutines do the work (and have already been written for you). This allows you to perform powerful hardware instruction calls with a single line of code.

An example subroutine call:

```
Device = 0 : Rem Tells the subroutine which device to speak to.
Relay = 3 : Rem Tells the subroutine to speak to the third relay.
Status = 1 : Rem Tells the subroutine to turn on the selected relay.
Relay8 Device, Relay, Status : Rem Subroutine Call to control the relay driver hardware.
```

Subroutines work well if you can get away with using a single subroutine to control a single device. But some applications (such as this month's LCD character display) may require several subroutines to control a single device. So in this application, it only makes sense to employ a module dedicated to controlling LCD character displays. A module can best be defined as a program within a program that contains its own set of subroutines. Figure 2 demonstrates the role of a module in a typical computer-control application.

Modules are easily added to a Visual Basic 4 application. If you missed out on last month's article "Opening Windows to the World," you may want to read it. This article provides step-by-step instructions on how to use the serial port of your computer under Visual Basic 4. You can download the VB4 application source, "CCW0001.ZIP," from my web site at: http://members.aol.com/ncdcat/.

Subroutine Name	Description	Example Usage
WriteData	Sends data to the controller formatted for communication using the NCD RS-232 modular network protocol. WriteData is used for sending commands and data directly to the LCD display.	*Not For Use by User*
Text	Sends ASCII text directly to the display. The Device parameter may be any number from 0 to 15 defining which LCD display on the network is going to receive the text. LIN is the line of the display that will hold the text. TXT$ contains the string of text that is displayed.	'Display "Welcome" on Line 1 of Device 0 CharacterLCD.Text 0, 1, "Welcome" 'Display "Network" on Line 2 of Device 5 CharacterLCD.Text 5, 2, "Network"
Backlight	Controls the on/off status of the backlight. Device is a number from 0 to 15. 0 turns off the backlight while 1 turns it on.	'Turn on (1) backlight of device 3 CharacterLCD.Backlight 3, 1
MoveCursor	Moves the cursor left or right. This function is useful as a backspace for editing purposes. Device is a number from 0 to 15 indicating which display will have the cursor relocated while Direction is a -1 for left movement or 1 for right movement. The cursor will be shifted 1 character in the direction indicated every time this subroutine is called.	'Incorrectly Spells "Welcme" on Line 1 of Device 0 CharacterLCD.Text 0, 1, "Welcme" 'Moves the cursor back 2 spaces CharacterLCD.MoveCursor 0, -1 CharacterLCD.MoveCursor 0, -1 'Display "ome". LINE=0 to avoid repositioning the cursor. CharacterLCD.Text 0, 0, "ome"
SetCursor	Sets the cursor type. Device is a number from 0 to 15 indicating which display will have the cursor setting changed. A status setting of 0 turns off the cursor, 1 turns it on, and 2 uses the underscore "_" character for the cursor.	'Turn Off Cursor for display at address 9 CharacterLCD.SetCursor 9,0 'Turn On Cursor for display at address 9 CharacterLCD.SetCursor 9,1
SetLine	Positions the cursor at the beginning of any of 4 lines of the display. Device is a number from 0 to 15 indicating which display will receive the SetLine command.	'Positions the cursor at Line 3 of a 20x4 display at address 0 CharacterLCD.SetLine 0, 3
RebootDisplay	Initializes the display for the first time. Device is a number from 0 to 15 that determines which display is to receive the reboot command.	'Reboots the LCD display at address 0 CharacterLCD.RebootDisplay 0
Scroll	Scrolls the contents of the display left or right. This function is useful for simple scrolling effects. Device is a number from 0 to 15 indicating which display will have the contents scrolled while Direction is a -1 for left movement or 1 for right movement. The display will be shifted 1 character in the direction indicated every time this subroutine is called.	'Scrolls the contents of the display 20 characters to the left. For Counter = 1 to 20 CharacterLCD.Scroll 0, -1 Next Counter
ClearScreen	Clears the display on the selected device.	'Clear the screen of LCD display at address 0 CharacterLCD.ClearScreen 0

Figure 8

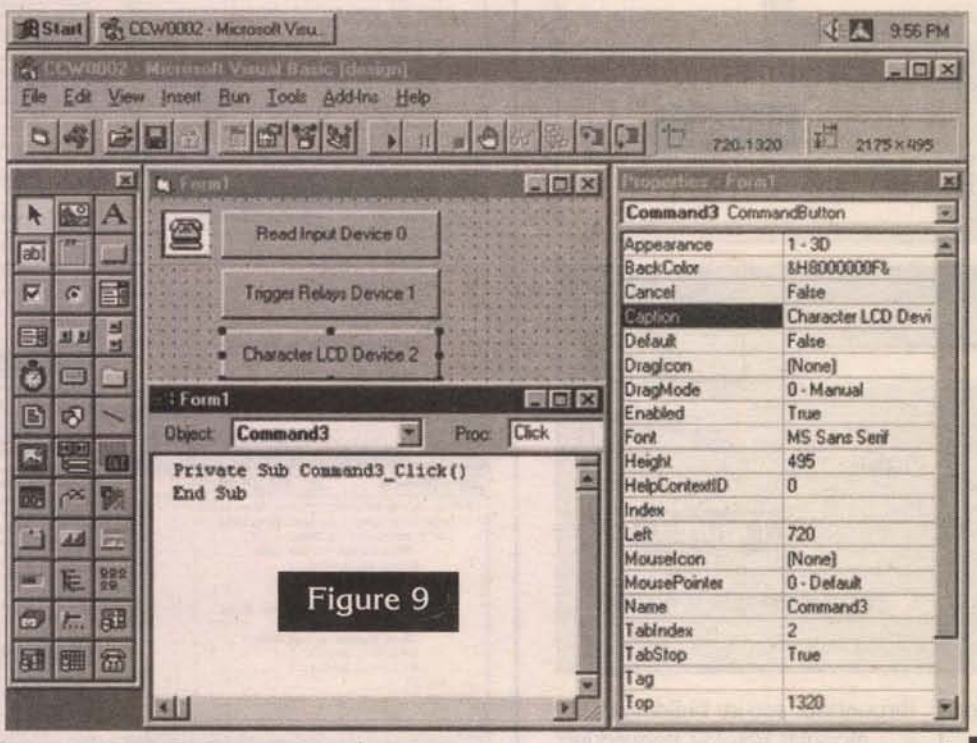


Figure 9

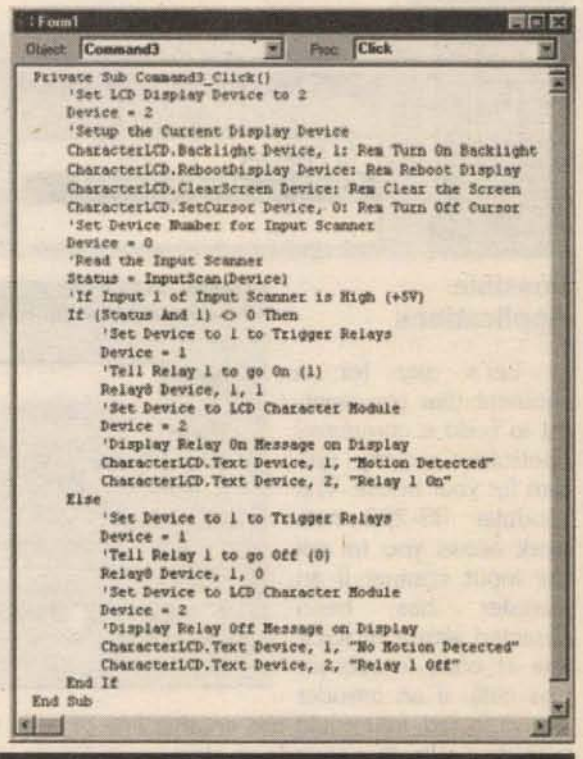


Figure 11. The above program demonstrates integration of three different devices attached to a single RS-232 serial port. Using the example code, you can easily ask the input scanner for a current status, and control a relay driver or a character LCD based on the received input.

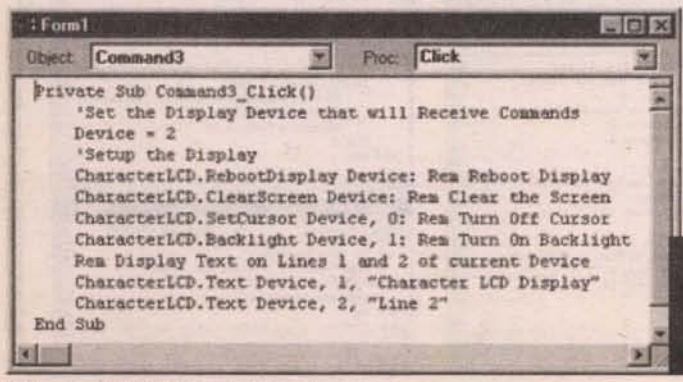


Figure 10. The above program demonstrates how to speak to the CharacterLCD module and how to tell subroutines within the module to control the display.

CharacterLCD.BAS Module

We'll start by creating a module that works with

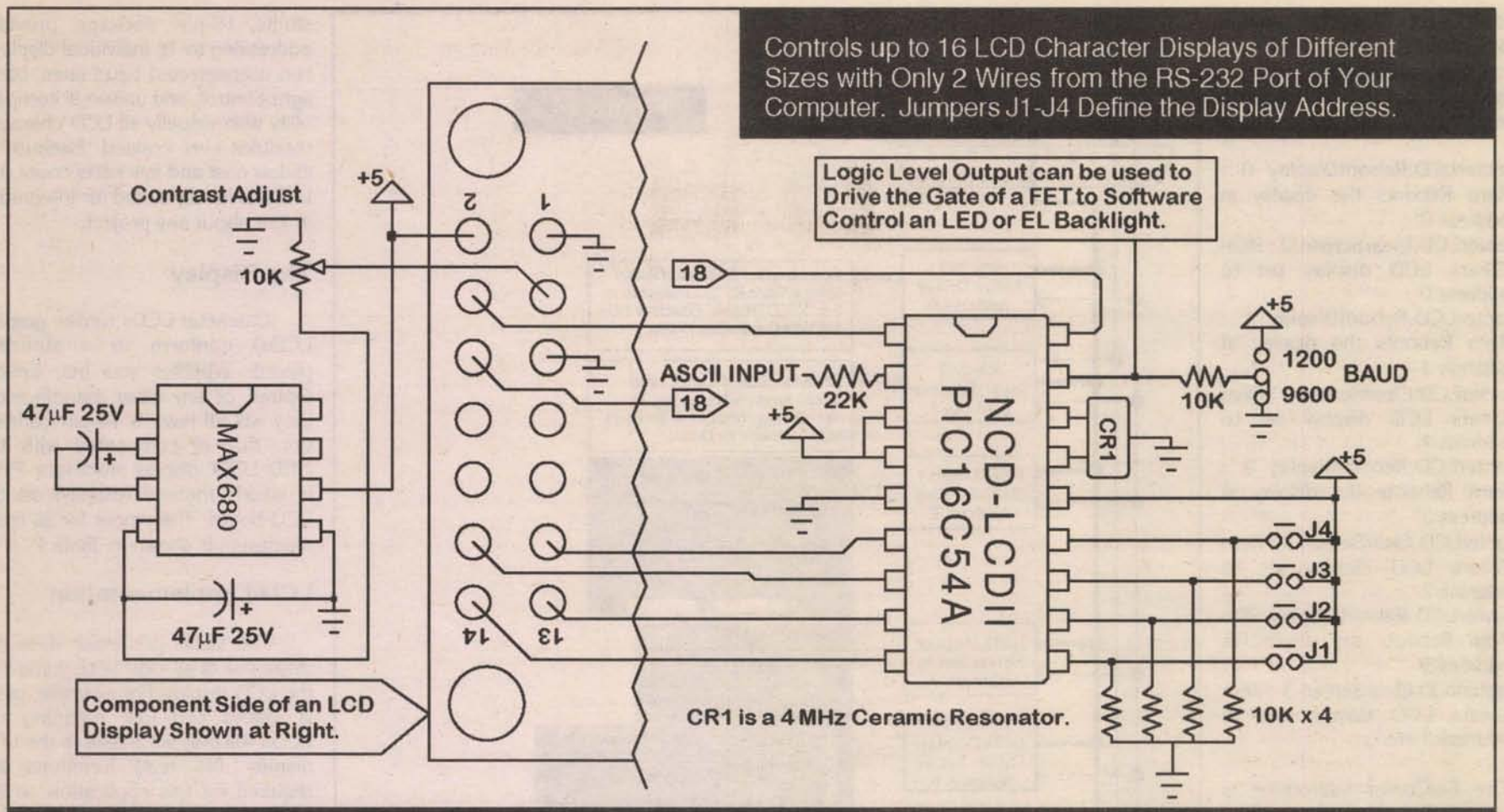


Figure 12

last month's Visual Basic 4 Professional application. If you are unfamiliar with modules, follow the picture examples and read the step-by-step instructions. It's really very easy and you'll quickly find that modules will open doors to future applications.

Shortcut: You may download the "CharacterLCD.BAS" module or the complete and read-to-run VB4 application "CCW0002.ZIP" directly from my web site at http://members.aol.com/ncdcat/ or you may follow the directions in this article and type in the source code from the pictures. If you are familiar with modules, save yourself some time and download this file and load the module into your application.

Step 1: Open VB4 with last month's program (or download the file CCW0001.ZIP from my web site). This program contains the essential parts required for RS-232 communications. The following steps will assume you have continued with last month's program. Please read the March issue, "Opening Windows to the World" for details on adding RS-232 communications to your application.

Step 2: Insert a module into the application as shown in Figure 3. Remember, a module is a program that contains its OWN set of subroutines.

Step 3: Use the "properties" window to rename your newly-added module to CharacterLCD (see Figure 4 for details). This module will be dedicated to controlling character LCD displays. A set of subroutines will be added to this module for controlling specific LCD display functions such as backlight, text, scrolling, and cursor type.

Binary Address	NCD Address	J1	J2	J3	J4	ASCII Range
0000	0	Removed	Removed	Removed	Removed	0-15
0001	1	Installed	Removed	Removed	Removed	16-31
0010	2	Removed	Installed	Removed	Removed	32-47
0011	3	Installed	Installed	Removed	Removed	48-63
0100	4	Removed	Removed	Installed	Removed	64-79
0101	5	Installed	Removed	Installed	Removed	80-95
0110	6	Removed	Installed	Installed	Removed	96-111
0111	7	Installed	Installed	Installed	Removed	112-127
1000	8	Removed	Removed	Removed	Installed	128-143
1001	9	Installed	Removed	Removed	Installed	144-159
1010	10	Removed	Installed	Removed	Installed	160-175
1011	11	Installed	Installed	Removed	Installed	176-191
1100	12	Removed	Removed	Installed	Installed	192-207
1101	13	Installed	Removed	Installed	Installed	208-223
1110	14	Removed	Installed	Installed	Installed	224-239
1111	15	Installed	Installed	Installed	Installed	240-255

Figure 13

Step 4: After adding the module to your application, subroutines will need to be added into the CharacterLCD module to control specific display functions. Figures 5 and 6 illustrate the addition of subroutines into a module.

Step 5: Add a subroutine into the CharacterLCD module for every subroutine shown in Figure 7. Make sure you type in the subroutines and names EXACTLY as shown. There are a total of nine subroutines that will be illustrated in the CharacterLCD.BAS module. Figure 8 offers an explanation of all subroutines explaining their individual hardware functions.

Note: You may want to add your own custom subroutines within the CharacterLCD.BAS module. You could easily add routines for displaying time, date, and various scrolling effects.

Implementation

Using the subroutines within the CharacterLCD.BAS module requires little effort. For the purposes of convenience and illustration, I have created a button on the form labeled "Character LCD Device 2" as shown in Figure 9.

Double-click the "Character LCD Device 2" button to see the empty code box (see the window labeled Form1 in Figure 9). When this new button is clicked, we'll want to control an LCD display set to address 2. Enter the code exactly as shown in Figure 10 into the Form1 window.

Figure 10 goes a long way in describing how to speak to the CharacterLCD module. The device number is set to 2 as the first order of business. Keep in mind you will have to set the LCD display controller to address 2 by installing jumper J2.

Before anything can be displayed, the LCD display hardware must be initialized. This is done by calling the CharacterLCD.RebootDisplay subroutine. Note the syntax for speaking to the RebootDisplay subroutine. The format is module.subroutine. For the purposes of this article, CharacterLCD will always be our module. We'll devote our time to using the subroutines from within the CharacterLCD module.

The next subroutine ClearScreen is pretty self explanatory. The variable "Device" is passed to EACH of these subroutines. Setting the device number to 3

would tell an LCD display module set to address 3 to clear its screen. For example, to initialize and clear multiple LCD display, the following statements could be used:

```
CharacterLCD.RebootDisplay 0 : Rem Reboots the display at address 0
CharacterLCD.ClearScreen 0 : Rem Clears LCD display set to address 0
CharacterLCD.RebootDisplay 1 : Rem Reboots the display at address 1
CharacterLCD.ClearScreen 1 : Rem Clears LCD display set to address 1
CharacterLCD.RebootDisplay 2 : Rem Reboots the display at address 2
CharacterLCD.ClearScreen 2 : Rem Clears LCD display set to address 2
CharacterLCD.RebootDisplay 3 : Rem Reboots the display at address 3
CharacterLCD.ClearScreen 3 : Rem Clears LCD display set to address 3 etc. ...
```

The SetCursor subroutine is used to turn off the cursor adding aesthetic appeal to professional installations. But during development, you may want to leave it on.

The next subroutine — Backlight — is used to turn on the backlight of the selected LCD display. As you can see, using the CharacterLCD module is really very easy.

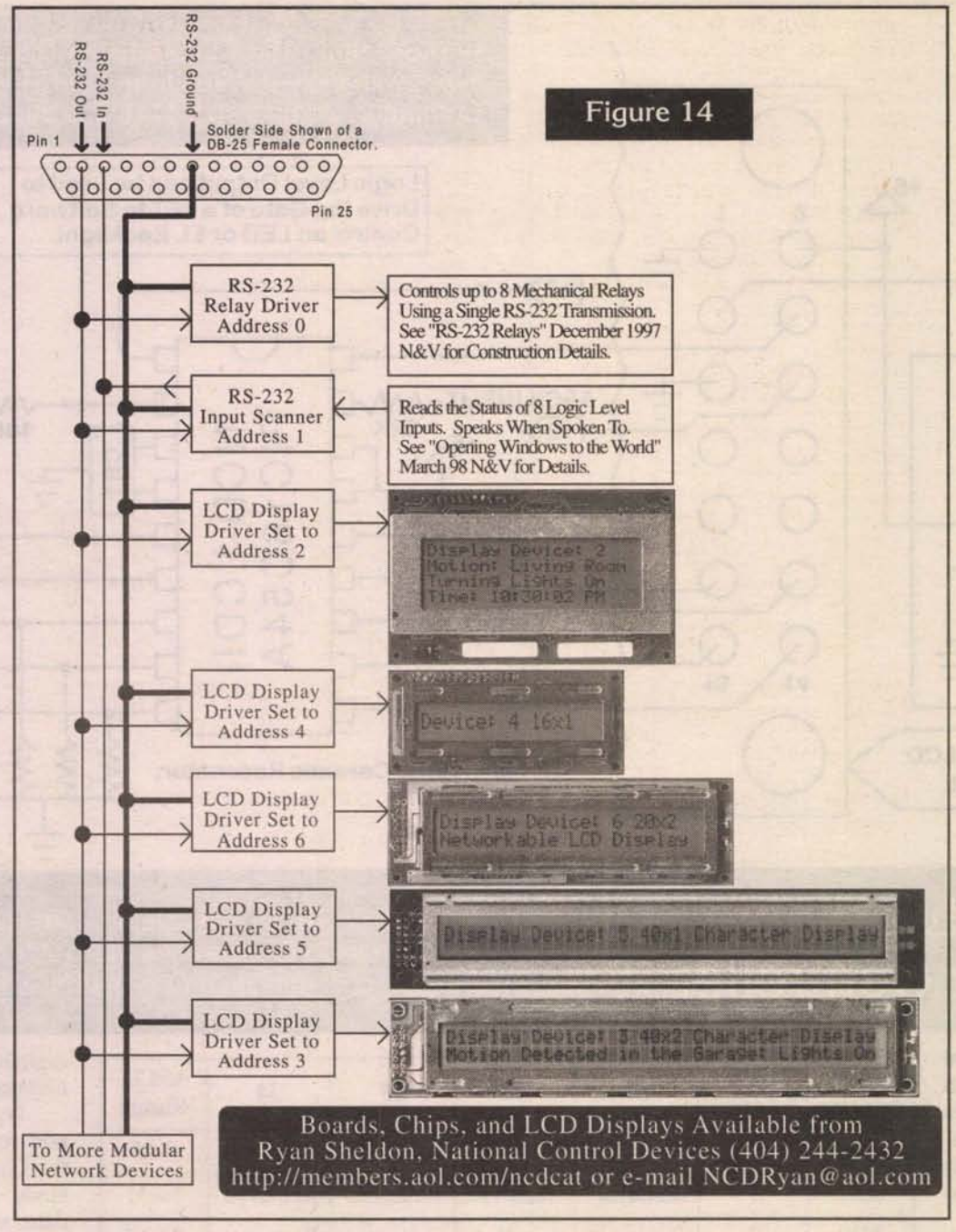


Figure 14

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Displaying Text on the LCD

Writing text to the user-selected display requires little effort. All you have to do is tell the Text subroutine which display is to receive the text (device number), which line the text will be displayed on (line number), and which string of text to display.

The Text subroutine is far more powerful than you might think. For example, using a value of 0 for the "line" parameter writes text starting from wherever the cursor happens to be located. A value of 1 positions the cursor at the left-most side of line 1 and then begins writing text in a right-reading direction. Similarly, line values of 2, 3, or 4 home the cursor on the beginning of the selected line. Note that line values of 3 and 4 should only be used on a four-line display.

Sending an actual text message to the display is also very easy. If you are using a 20x4 display, your text message for line 1, 2, 3, or 4 should never exceed 20 characters. Similarly, if you are using a 40 character display, your text message should not exceed 40 characters. Extra characters will be truncated.

Project Integration

As promised, the LCD character display can share the serial port with a relay driver and the input scanner you learned to build in previous articles. Figure 11 provides a self-explanatory integration of the relay driver, input scanner, and the CharacterLCD module in a real-world application. Read through the code just to get an idea of how easy it is to use subroutines and modules to control multiple devices.

The Hardware

As you can see in Figure 12, building the character LCD display controller is really very simple. The controller consists of little more than a PIC, a ceramic resonator (CR1), and a few resistors.

LCD displays require a negative voltage to position the crystals into view. This voltage is easily generated by using one-half of a MAX680. The 680 can generate up to -10 volts which is compatible with any size character LCD. The 10K potentiometer controls the LCD drive voltage level. Varying the LCD drive voltage level changes the contrast. The 47μF capacitors on the 680 serve as a chargepump and are critical for proper operation. Do not confuse the LCD drive voltage with the supply voltage. The supply voltage must provide +5 volts for the logic of the LCD display.

The LCDII Interface

Processor RS-232 data comes into the NCD-LCDII display processor on pin 2, gets decoded, and drives the logic, command, data, and strobe lines of the character LCD ... but ONLY if data is sent to the correct address as defined by jumpers J1-J4.

The LCDII is perhaps the easiest, most expandable, and cheap LCD display controller available. This single 18-pin package provides addressing to 16 individual displays, two user-selected baud rates, backlight control, and universal compatibility with virtually all LCD character modules ever created. Because of its low cost and low parts count, the LCDII is ideally suited for integration in just about any project.

The Display

Character LCDs (unlike graphic LCDs) conform to a standard pinout. Whether you buy Epson, Optrex, or any other manufacturer, they will all have a 14-pin connection that is compatible with the NCD-LCDII display processor. Pin 1 is clearly marked (usually) on the LCD board. The pinout for all manufacturers is shown in Table 1.

LCDII Implementation

The LCDII processor does not make use of all logic lines going into the LCD display. For example, pin 5 is always tied low, meaning the LCDII will only write data to the LCD display. No read functions are required for this application so the read mode is never used. In addition, pins 7 to 10 are never used. The LCD display is controlled by the LCDII processor in four-bit mode. The LCDII must provide four data bits (on pins 11 to 14), and then a strobe pulse (pin 6). This must be done twice to write a single character to the display.

Hardware Networking

As you know by now, up to 16 modular networkable devices can be attached to a single RS-232 serial port. The NCD-LCDII implements this very simple networking system by making use of four jumpers. These jumpers define a range of ASCII characters that will be used for all instructions. For example, if you wanted to set a modular networkable device to address 0 (see Figure 13), you would remove jumpers J1-J4, and the device set to address 0 would only listen to ASCII characters 0 to 15. Similarly, if a device were set to address 6, you would need to remove jumpers J1 and J4 and install jumpers J2 and J3. The device set to address 6 would ONLY listen to ASCII characters 96 to 111. As illustrated in the table below, your computer (or microcontroller) can provide up to 256 ASCII characters, permitting up to 16 individual devices to listen to their own range of characters.

Networkable Interface

So far you've learned how to write the software and build the modular networkable hardware. Now all you have to do is attach the networkable devices of your choice to a single RS-232 serial port (in any combination of your choice). Figure 14 illustrates RS-232 connection of multiple modular networkable devices. Note that only three wires are required to support this network. This illustration demonstrates the power modular networkability offers the user.

Next time, I'm going to highlight inexpensive wireless communications methods. Watch for next article—"Naked Data" — and see how easy (and cheap) it is to control the world without wires ... all from your desktop PC using Visual Basic. **NV**

I would again like to encourage readers to contact me by phone at (404) 244-2432 or E-Mail me at ncdryan@aol.com with technical questions. If I'm not around, please leave a message. Your call will be returned. The NCD-LCDII interface processor is only available from National Control Devices, (404) 244-2432, http://members.aol.com/ncdcat/.

National Control Devices is owned by Ryan Sheldon, who actively supports the research and software developments for the Language Research Center, Georgia State University.

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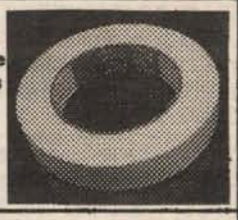

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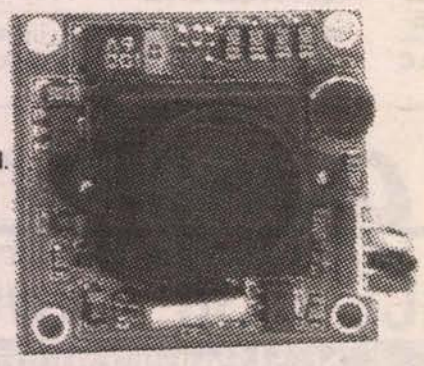

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Card requires a 16 bit expansion slot. Captures Video in .avi format at various frame rates & size. Frame graber saves pictures in the following format (.jpg) (.bmp) High Q card will work with both NTSC & PAL Video devices. High Q card will handle up to two Video input devices & audio input devices. Comes complete with software.
Price $99.95

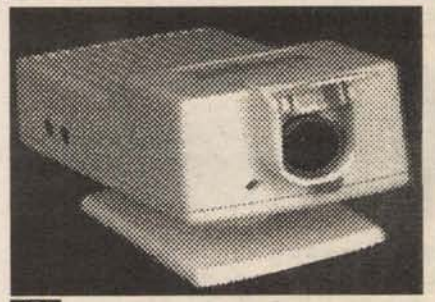
3.5" 1.44MB FLOPPY DRIVE
NEWTRONICS CO. # D359T5
5 VDC - WHITE FACE PLATE
FOR USE WITH IBM & IBM Compatible computers. HIGH Density. ***BRAND NEW ... $19.95***

SEALED BALL BEARING
MFG: FAFNIR PART # 203 VV
■BORE: .668" ■Diameter: 5.75" O.D.
■ .47" thick
List Price $7.00
SALE PRICE...
$1.50

WHY PAY MORE?

PANELITE - LIGHTED PUSHBUTTON SWITCH
SIZE: 1-3/8"H x 0.85" DIA. SOLDER/QUICK CONN. TERMINALS. SPDT - N/O, N/C BRIGHT FULL SURFACE ILLUMINATION. Opp. force: 7 ONCE complete with hardware
BRIGAR SALE - YOUR CHOICE ..... ***$1.50 EA.***

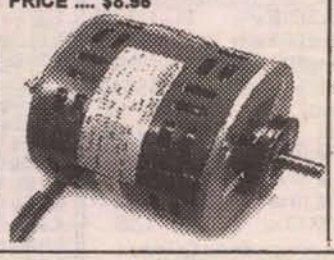
PART #	COLOR	DESCRIPTION
LB-16WK12-FJ	Green	ON/OFF 3A 125 VAC 3A 250 VAC
LB-15WK12-GJ	BLUE	MOM. 0.4VA MAX 28V MAX
LB-15WK12-EJ	YELLOW	MOM. 0.4VA MAX 28V MAX



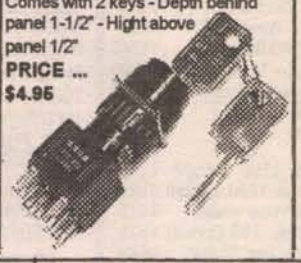
HOWARD ENTERPRISES
TELECAMERA #HA4700 COLOR CCD CAMERA with built in Microphone
CAMERA COMES COMPLETE WITH POWER ADAPTOR - VIDEO CABLE - SWIVAL BASE
Camera uses a 1/3" CCD advanced imager, automatic gain control, electronic auto iris, fixed focus glass lens, and attractive enclosure - designed for videoconferencing. Real time capability. composite signal output for standard interface to : TV monitors,VCRs,use with video networks,frame grabber compatibility etc ....
•**Scanning system**: ntsc (525 vert lines 300 fps)
•**sync system**: internal sync only
•**Resolution**: Horizontal TV lines 330
•**Max illumination**: 10 lux •**NTSC Compatable**
•**Focal distance**: 600mm fixed
•**Video S/N Ratio**: 46dB
•**IRIS System**: Electronic auto iris
•**CCD imaging**: 532h x 500v 270k pixels
•**Video output**: composite video
•**Rear connections**: Audio & video RCA jack, AC adaptor jack
•**Size**: 68.5mm(w) x 43mm(H) x 122mm(D)
BRAND NEW FACTORY BOXED..... *$189.95*

Nidec
Nidec BETA V High Volume FAN # TA600DC
Model # A34263-58
■VOLTAGE: 12 VDC ■2.0 AMP ■200 cfm
■24 watt ■VOLTAGE RANGE 6-14VDC
■ BALL BEARING ■ Sound level: 55.8 dBA
■Aluminum housed - ■ 5 blade phenolic impeller. ■ UL & Csa Approved.
■Size: 6-3/4" Diam. x 2" thick
Brand new factory packed.
list price...$56.95
BRIGAR PRICE $14.95

ROBBINS & MYERS MOTOR
#KP-F330 •Volt: 220 vac
•Amps .60 •Hz 60 •RPM 1150
•HP 1/20 •PH 1 •Duty: Int.
4" wire leads Weight 3-1/2 lbs
Size: 4-1/2"H x 4"Dia.
Shaft Dim. 3/4"L x 5/16"Dia Flatted.
Requires 4-440vac cap not included.
PRICE $8.95



eao■ KEYLOCK SWITCH
PART #51-371.O.D.
3 position (ON-OFF-ON)
6 Amp 250 Vac
5 Amp 75 Vdc
0.5 Amp 250 Vdc
Mount in 5/8" hole - plastic housed - GP quick conn or solder terminals. Comes with 2 keys - Depth behind panel 1-1/2" - Hight above panel 1/2"
PRICE ... $4.95



JOHNSON #27120
6-12VDC Toy/Hobby Motor
Miniature - Reversible Dc motor. 6vdc @ 6000 RPM
12 Vdc @ 12,000 RPM
Size: 1-1/4"L x 1"W x 13/16"
Shaft: 3/4"L x 1/16"Dia.
Price ..... 60¢ ea.
10 For $4.00

PICO M600 AUDIO & VIDEO MODULATOR
•FEATURES: SAW filtered •IF Modulation •Encoder compatibility, using an external if loop-thru, to accommodate pay-per view or scrambled signals •excellent audio & video linearity - •ul listed •High output: 60 dBmv •Separate 4.5 MHz input for stereo encoder operation •Output capability to 560 MHZ

RF:
•output channels 2-60, IRC, HRC and FCC Docket 21006 offsets
•Output Level: 60dBmV +-2dB (channels 2-36)
•50 dBmV +-2dB (channels 37 - 60)
•Output Adjustment Range: 15dB
•Spurious Output: 60dB Below Video carrier (@ A/V carrier ratio - 15dB)
•Freguency stability +-5 KHz
•Audio/Video Ratio: -7 dB to -25 dB
•Composite IF output: 35 dBmV nominal

General:
AC power: 108 to 125 VAC, 60 Hz
Fuse: .25 amp
Modular construction allows the unit to be reconfigured to any output channel by qualified service center. modulator is designed for adjacent channel headend use. Rack mountable unit. Size: 17"L x 19"w x 4-1/2"h

Video:
•Input level: 1 V p-p min for 87.5% modulation.
•Input Type: Clamped video, negative sync
•visual C/N: 60 dB @ 4 MHz BW
•Freq. response: +-.5dB (30 Hz)

Audio:
•Input imped. 5k ohms unbalanced.
•Input level: 0.5 V p-p for 25 KHz peak deviation
•Pre-emphasis: 75 msec switchable for BTSC stereo
• flatness: +- 1.5 dB (50 Hz to 15KHz)
4.5Mhz BTSC input level: 10mV to 1Vrms
•Subcarrier freq. 4.5 MHz (+-2KHz)

PRICE.... $225.00

2 x 16 SMART LCD DISPLAY *GOLDSTAR*
MODEL #LC16208 •Character: 16 •Line: 2 •Power requirement: 5vdc @ 3mA •Window size: 5/8" x 2-1/2"L - 2 goldstar drivers: #GM9120 - Display comes mounted on a 3-3/4" x 4-1/4" circuit board with 16 mini push button switches and 3 rectangular LED'S. (Comes complete with schematics , 68hc11 program and initialization steps)
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DISPLAYS COMES COMPLETE WITH 3.5" DISKETTE. FILES CONTAIN 68HC11 PROGRAM, LIST OF COMMANDS schmatics & initailzation steps.

1 MEG 30 PIN SIMM MEMORY MODULE
GOLDSTAR #GMM781000NS70 NON PARITY - 70 ns
BRIGAR SALE PRICE $4.95

MERRIMAK MAGNETICS CORP.
ISOLATION TRANSFORMER
SIZE: 14-3/4"L x 6"W x 12"H
WEIGHT: 135 LBS. Hipotted - ul appr.

PART# T86E-222
TRANSFORMER, 8 KVA ***PRICE ...*** ~~$350.00~~
480V 3-PHASE INPUT **$225.00**
OUTPUT: 208V 3 PHASE, 120V Single phase

PART# T86E-221
TRANSFORMER, 8KVA ***PRICE ...*** ~~$350.00~~
208V 3 PHASE INPUT **$215.00**
OUTPUT: 208V 3 PHASE, 120V Single phase

Write in 88 on Reader Service Card.

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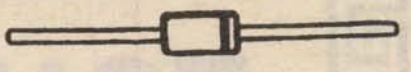

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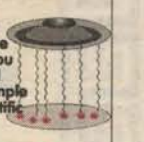

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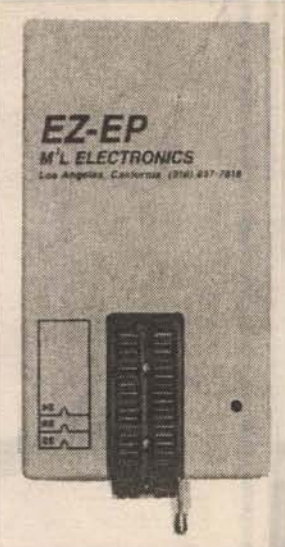

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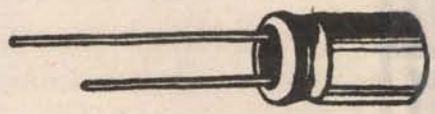

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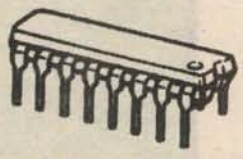

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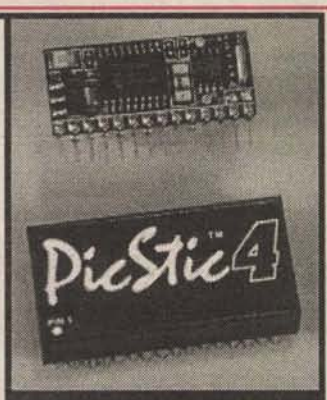

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Build Quick Henry to Measure Inductance

Build this simple adapter for use with your audio or RF signal generator and you can measure inductance values from 1 microhenry to over 1 henry. It uses an internal or external analog microammeter, or an oscilloscope, as a peak or null indicator.

Measuring the inductance of a choke, transformer, intermediate frequency (IF) can, toroid, open-air, or any other coil is a relatively clumsy process for the home experimenter or small repair shop. Unless equipped with an inductance bridge, the measurement of inductance is usually avoided because of the difficulty in making the measurement.

However using "Quick Henry" and two simple charts, anyone with an audio frequency (AF) generator can measure inductance quickly and easily from 1 millihenry (mH) to over 1 henry (H). With the use of a radio frequency (RF) generator, measurements can be made down to one microhenry (uH). Furthermore, using a calculator or simple BASIC computer program, measurements can be calculated beyond these ranges.

In addition, Quick Henry will allow you to determine the resonant frequency and sharpness of response ("Q") of audio and RF circuits from below 100 cycles per second (hertz, or Hz) to over 15 megahertz (MHz) with reasonable accuracy. The resonant frequency of unmarked IF transformers can be easily identified, and you can determine the inductance of

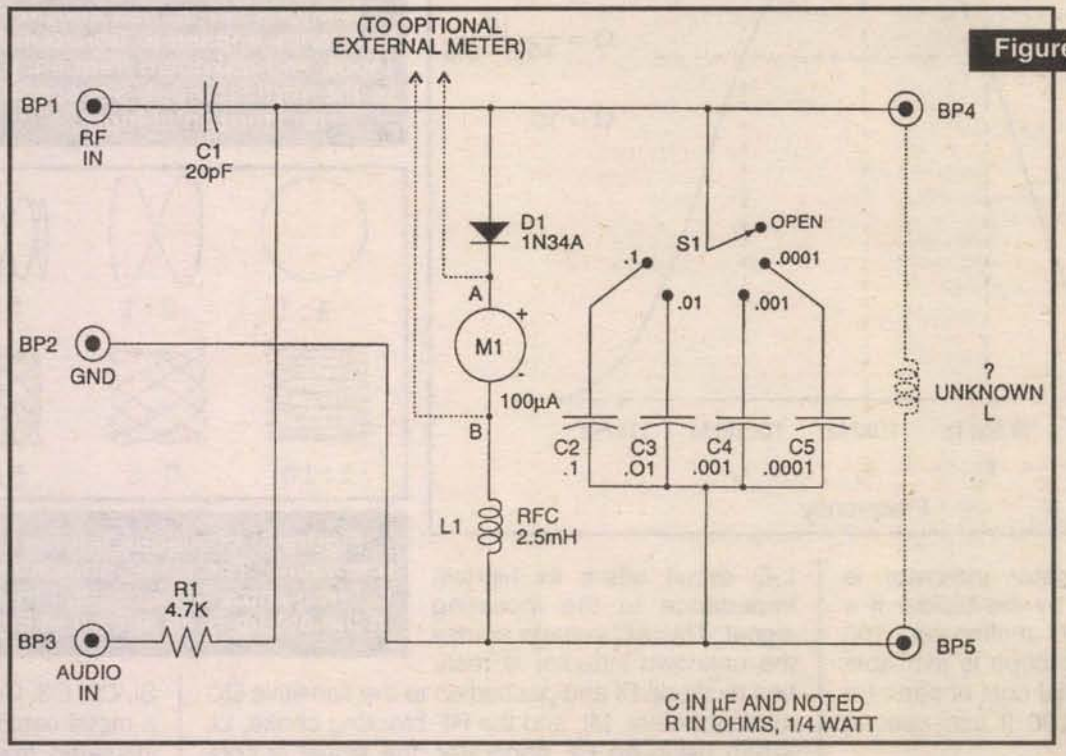


Figure 1: Quick Henry Schematic

Figure 2: Resonant Frequency vs. Inductance (Audio Range)

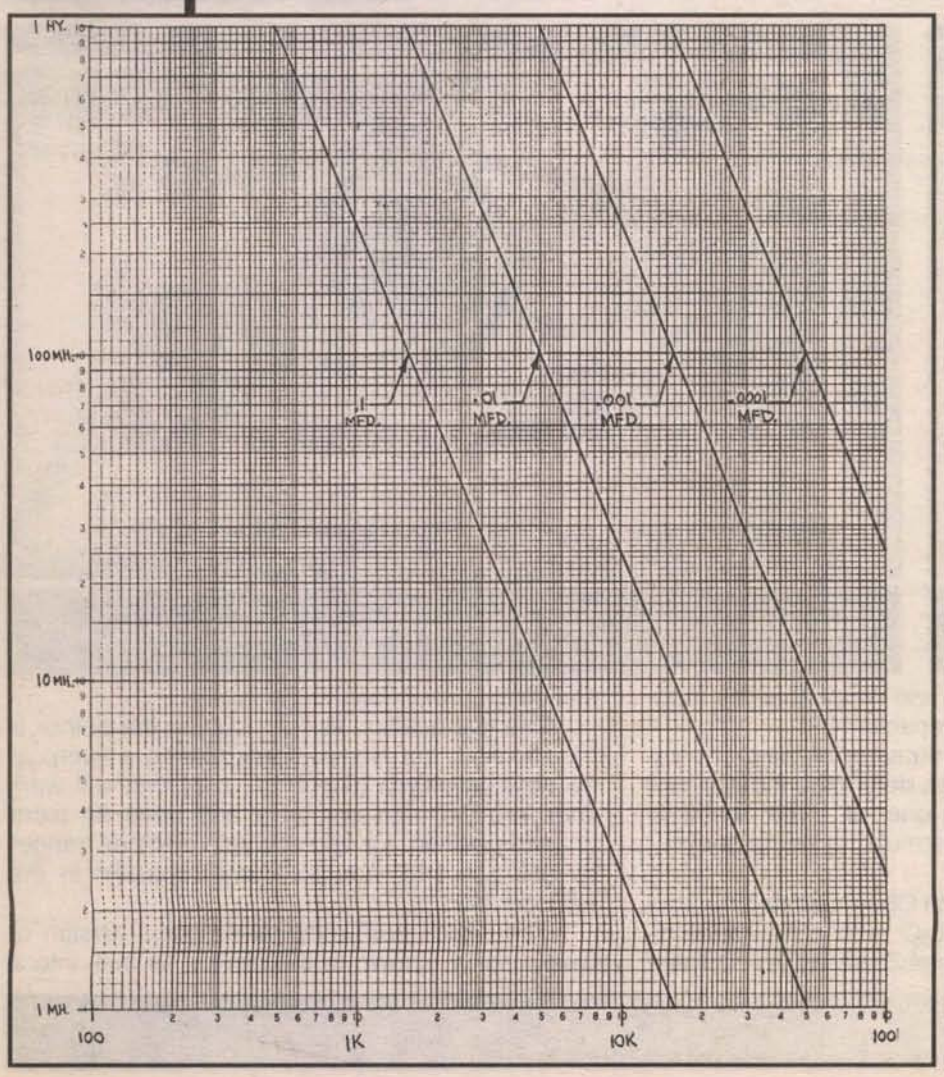
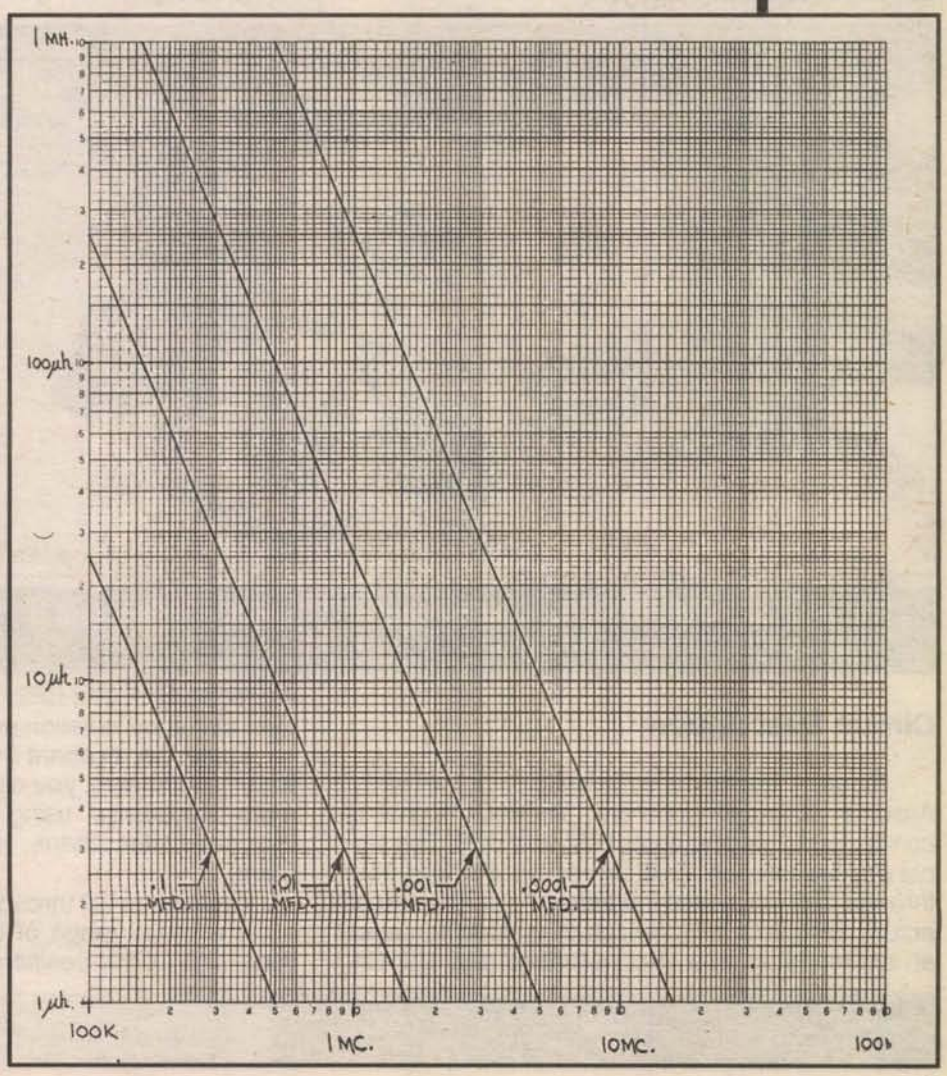
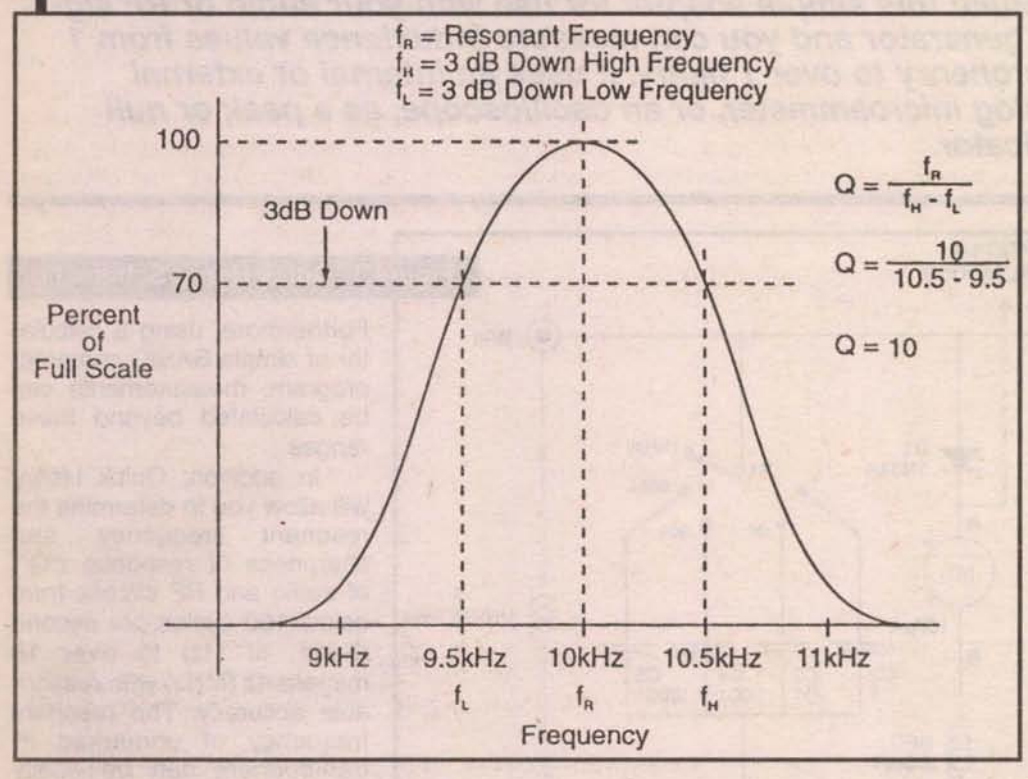


Figure 3: Resonant Frequency vs. Inductance (RF Range)



unmarked filter chokes, slug-tuned coils, RF chokes, etc. You can design, test, and trim air-wound coils and audio band pass circuits to your requirements.

Figure 4: Calculating Q with Quick Henry



Quick Henry's built-in meter indicator is optional, and may be omitted by the builder if a 10,000 ohms/volt or better DC multimeter, 100 microamp DC meter, or oscilloscope is available as an external indicator. The total cost of parts for Quick Henry is less than $10.00 if you use an external indicator.

or C5), which is placed in parallel with the unknown inductor.

The audio input frequency is varied and, as the resonant frequency of the parallel combination of the unknown L and the selected C is approached, the voltage across BP4-BP5 increases sharply. At its resonant frequency, the parallel L-C circuit offers its highest impedance to the incoming signal. This AC voltage across the unknown inductor is rectified by diode D1 and passed on to the sensitive DC microammeter, M1, and the RF-blocking choke, L1. When using an RF generator, the signal is connected to BP1 and BP2, and coupled to the resonant circuit by isolation capacitor C1.

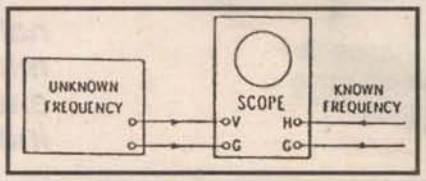


Figure 5: Typical oscilloscope Lissajous set-up has known frequency applied to horizontal input, and unknown frequency to the vertical input. Set scope for Horizontal Input.

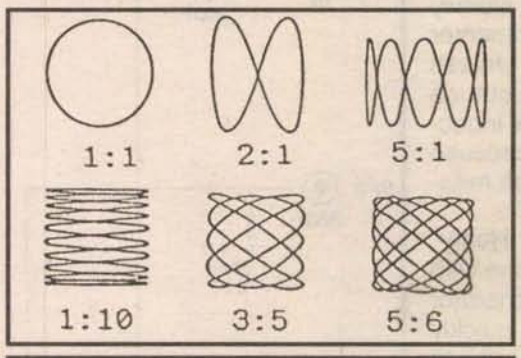


Figure 6: Lissajous figures using sinewaves. The ratios shown are vertical frequency to horizontal frequency if the set-up is as shown in Figure 5.

Once the resonant frequency of the L-C combination is known, you can determine the approximate inductance using one of three methods described later: charts, formula, or computer program.

Capacitors C2 through C5 — selected by S1 — allow a broad range of L-C ratios and combinations. The OPEN position of S1 allows you to measure external resonant circuits, or to "trim" an inductor with exactly the value of capacitance needed for resonance at a desired frequency.

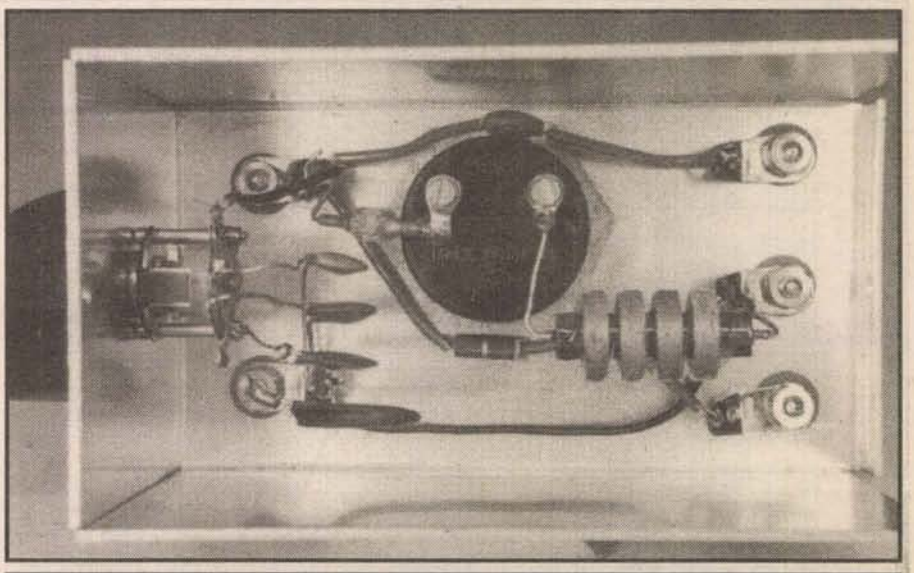
Resistor R1 and capacitor C1 are used to prevent the signal generators from being loaded down by the L-C circuit, which has a very low impedance when not in resonance. Diode D1 must be a germanium diode, since it conducts with a much lower voltage loss than a more common silicon signal diode. RF choke L1 is needed to prevent the meter from acting as a short circuit to the L-C circuit at high-resonant frequencies.

Construction

The author's with-meter unit was built over 30 years ago with parts commonly available at that time. The exact enclosure and meter used then are no longer available, but are not critical. You may have an appropriate small metal or plastic cabinet and sensitive meter in your junk box, or can retrieve them from some other equipment you don't need.

In any case, construction of the unit requires no special techniques. Wiring is not critical, but don't make the leads longer than necessary, and place S1, C2, C3, C4, and C5 near BP4 and BP5. If using a metal cabinet, be sure that all binding posts are insulated from the box; there shouldn't be any electrical connections to the box.

The unknown inductor is connected to the "?" binding posts, and a parallel capacitor selected.



Quick Henry contains few parts, so it is very inexpensive to build.

Circuit Description

Figure 1 shows the schematic of Quick Henry. Assume an audio generator sinewave signal is connected to binding posts BP2 and BP3. The signal passes through isolation resistor R1 and then through the unknown inductance (L) connected across BP4 and BP5. Switch S1 is used to select an appropriate value of capacitance (C2, C3, C4,

The five-position switch used by the author is hard to find, but Radio Shack makes a two-pole six-position switch (see Parts List) that will work fine. You just use one pole and have an extra unused position. Or you can add another "range" by using a 1mF non-polarized capacitor in the sixth position.

The "black box" external-indicator version of Quick Henry, shown in the photos, is built into a

Fuji slide box, designed to hold 36 35mm slides (usually found at photo-finishing stores by just asking). Or look through your old slides and you'll probably find some in these or similar thin plastic boxes that make easily cut cabinets for small electronic projects like this one.

If you intend to use an available external multimeter to detect the resonant condition instead of building the meter into Quick Henry, an analog meter is much preferred to a digital meter. You can observe the analog needle move up scale to a maximum much more easily than interpreting an updating and constantly-changing digital display.

For an external indicator, bring out two wires and clip leads for connection to the external multimeter. These points are marked on the schematic as A and B. Be sure to use red (positive) and black (negative) clips to indicate proper polarity for external connections.

When using an external multimeter to sense resonance instead of the built-in meter arrangement, the multimeter should be set on its lowest DC current or voltage range, observing proper polarity. When using an oscilloscope to sense the resonance voltage increase, set the sweep frequency to see many cycles, and the sensitivity to show the increased amplitude at resonance.

Operation

Most inductors with many turns of wire wound on a ferrite or iron core measure over 1 mH, and can be checked using an audio generator with Quick Henry. Typical air-wound coils are in the microhenry range, so use an RF generator. Never connect both generators to Quick Henry at the same time, as all sorts of spurious signals will result.

Connect the generator "ground" lead to BP2, and the "hot" lead to either BPI (RF) or BP3 (AF). If you are using the external indicator version of Quick Henry, connect the clip leads to the external DC meter or oscilloscope, observing polarity. For more accurate frequency readings than your signal generator readout, you can connect a digital frequency counter directly across the signal generator leads, observing common grounds.

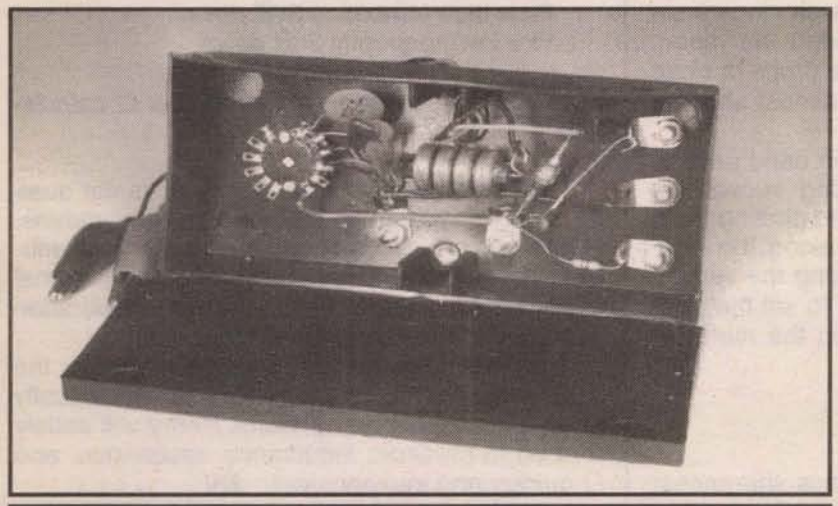
To start with, set SI to the ".OOI" position. Beginning at the low-frequency end of the signal generator, vary the frequency (changing generator frequency bands when necessary) until a clear meter upward deflection is observed. If using an oscilloscope, the amplitude of the display should increase to a peak.

Some minor spurious responses may be seen (especially when using an RF generator and measuring in the low microhenry range), but these can be ignored. Look for a relatively high response as your proper indication of resonance.

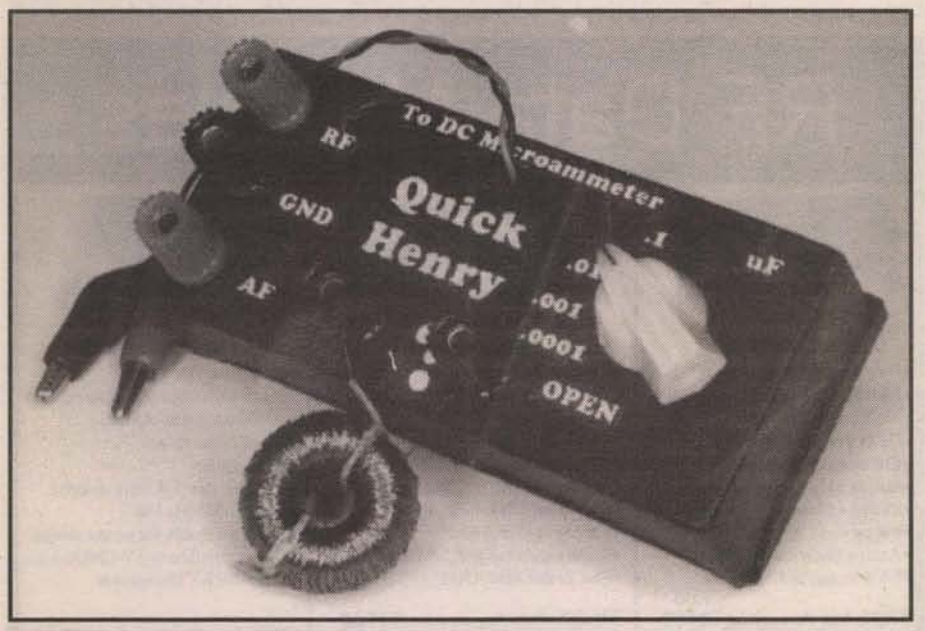
If you don't find any significant response, try switching SI to the next higher value (.01), and sweep the frequencies again. When you do get a response, it will be quite definite, and might "pin" the meter (or scope display). Adjust the generator output for a comfortable peak reading. Most audio generators have enough output to deflect a sensitive meter well beyond full scale, and RF generators will give at least one-half scale under most conditions. The best accuracy will be obtained with the highest value of C that gives a sharp peak meter reading, so re-adjust the position of SI, if necessary.

A broad peak, that is, one which is not too definite in relation to the varied frequency, is "low Q," and may be improved by using a higher value for C (setting SI to a higher value).

Once you have found the best setting for SI (and it really is much easier than it may sound), you can use Figure 2 to determine the inductance of the unknown coil if you're using an audio generator, or Figure 3 if you are using an RF genera-



The meter-less Quick Henry has few parts and can be built into a 35mm slide box for under $10.00.



The unknown inductor is connected to the "?" binding posts and a parallel capacitor is selected with the switch.

```
10 REM * CALCULATE INDUCTANCE *
20 REM * F=RESONANT FREQUENCY WITH PARALLEL CAPACITOR *
30 REM * C=CAPACITOR IN PARALLEL WITH INDUCTOR *
40 REM * L=INDUCTANCE
100 INPUT"RESONANT FREQUENCY IN (1) KILOHERTZ OR (2) MEGAHERTZ";A
110 INPUT"ENTER RESONANT FREQUENCY";F
120 IF A=1 THEN F=F/1000
140 INPUT"ENTER CAPACITANCE IN MICROFARADS";C
200 L=1/(C*(6.28*F)^2)
205 IF A=1 THEN L=L/1000
210 PRINT"THE INDUCTANCE IS";L;
220 IF A=1 THEN PRINT"MILLIHENRIES":END
230 PRINT"MICROHENRIES"
```

LISTING 1: BASIC program to determine inductance when parallel capacitor and resonant frequency are known.

PARTS LIST

RI - 4.7K 1/4 watt resistor (Radio Shack #271-1330)
C1 - 20 or 47 pF ceramic disc capacitor (Radio Shack #272-121)
C2 - .1 uF metal-film capacitor (Radio Shack #272-1053)
C3 - .01 uF metal film capacitor (Radio Shack #272-1051)
C4 - .001 uF ceramic disc capacitor (Radio Shack #272-126)
C5 - .0001 uF (100pF) ceramic disc capacitor (Radio Shack #272-123)
DI - IN34A germanium diode (Radio Shack 276-1123)
SI - Five-position switch (see text. Radio Shack #275-1386)
LI - 2.5 mH RF choke (Ocean State Electronics #6302)
BPI-BP5 - Insulated binding posts (Radio Shack #274-662)
MI - 0-100 microampere meter (see text)
Case - See text
Selector Knob - To fit S1 shaft (Radio Shack #274-424)

SOURCES

- **Your** junk box
- Your local **Radio Shack** store
- **Ocean State Electronics**
  P.O. Box 1458
  Westerly, RI 02891

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tor. Enter the horizontal scale at the resonant frequency as read on the generator dial or frequency counter and move directly upward until you intersect the line representing the value of capacitance selected by SI. Then move straight to the left and read the value of the unknown inductance on the vertical scale.

Figures 2 and 3 have been plotted showing only the values of capacitance shown in Figure 1. If you desire to use any other values, either internally or connected to the binding posts externally, you can calculate the unknown inductance as follows:

$$L = \frac{1}{C(6.28F)^2}$$

L = inductance in microhenries (uH)
C = capacitance in microfarads (uF)
F = resonant frequency in megahertz (MHz)

When using this formula, be careful about your units; 1000 kilohertz is equal to 1 megahertz, and 1000 microhenries is equal to 1 millihenry. For example, a frequency of 10 kilohertz is .01 megahertz, and an inductance of 10,000 microhenries is 10 millihenries.

A third method to determine the inductance once the resonant frequency is known is to use the simple BASIC computer program shown in LISTING 1. This has worked without modification with Radio Shack TRS-80 BASIC, IBM GWBASIC, QuickBASIC, and QBASIC.

For determining the resonant frequency of, say, an IF transformer, connect one of the windings (an ohmmeter will identify the windings by continuity) to BP4 and BP5, and set SI to OPEN. Using an RF generator, find the frequency that peaks the meter, and read this resonant frequency right off the generator dial. With S1 in the OPEN position, a particular value of capacitor may be placed in parallel with an unknown inductor, and the resonant frequency determined in the same way.

Series resonant circuits can also be measured across BP4 and BP5 by noting a DIP in the meter reading rather than an increase. When not in resonance, the reactance of a series L-C circuit is high and the meter reading is high since most of the input signal is going through the meter. However, the series L-C reactance drops to close to zero at resonance, effectively almost shorting out the meter circuit.

You can actually plot the audio band pass of an R-C or L-C network by taking successive meter readings near resonance and plotting them on graph paper, with frequency along the horizontal axis, and meter reading along the vertical axis. In this case, it is convenient to set the generator output to read full scale on the meter at resonance.

Finding Q

To find the Q (relative bandpass sharpness) of a resonant circuit, you need to determine the frequencies at which the meter reading is approximately 70% of the maximum value. These are the 3dB-down power settings.

Set the peak meter reading to full scale by adjusting the generator output. Now vary the input frequency on both sides of the resonant frequency to the points where the meter reads about .7 of full scale.

Note the frequencies where these meter readings occur and apply the following simple formula:

Q = Fr/(Fh-Fl)

Fr = resonant frequency
Fh = high frequency 3dB down
Fl = low frequency 3dB down

Figure 4 shows an example of a Q calculation.

The accuracy of Quick Henry does not qualify it as a laboratory standard by any means. Numerous errors are cumulative, such as distributed capacitance, stray inductance, the external capacitance of test leads, and the calibration accuracy of the signal generators used.

However, for the home experimenter or the small repair shop or lab, which do not usually need extreme accuracy, Quick Henry will satisfy a need to measure inductance, resonance, and Q quickly and inexpensively. **NV**

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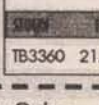

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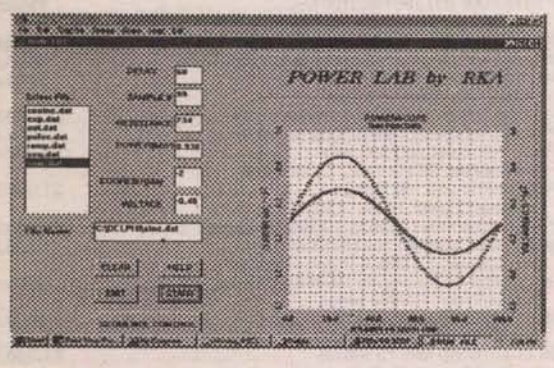

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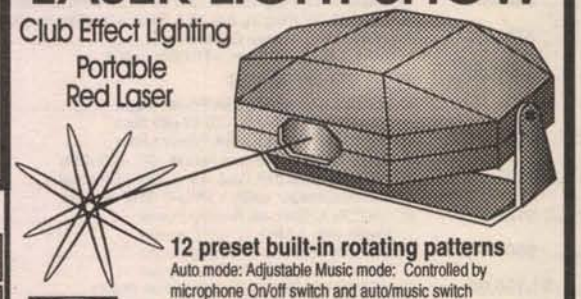

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Write In 94 on Reader Service Card.

AMATEUR ROBOTICS

by Karl Lunt

With the deadline for the Northwest Regionals of the Trinity College Home Fire-Fighting event less than two months away, I naturally devoted all of my precious robot time to ... hacking a GameBoy. I don't know what it is about these little gadgets that makes them so much fun to hack, but I have this vision of a GameBoy-guided robot and I've become slightly obsessed about making that happen. Note, however, that I did spend some time this month on a project somewhat related to the Fire-Fighting contest; more on that in a bit.

As you know from last month's column, the Nintendo GameBoy has a rabid circle of hackers and developers who have created some serious tools for writing and testing GameBoy applications. Besides an excellent C compiler, assembler, and linker, members of the GameBoy Developers Ring (GBDR) have created tools to help design game backgrounds, sprites, and music, and have even developed hardware for linking together up to four GBs for interactive play. One person, Jeff Frohwein, has even hooked a servo-based robotic hand to his GB; check out his web page for a picture or two of his machine.

The GB cartridges make perhaps an ideal module for moving code from place to place. They have no moving parts, a small package, and little power drain. These cartridges come in six different formats, based on the components inside. The most common variety contains read-only memory, in the form of a programmed ROM and, for really large games, a memory banking controller. You can spot this kind of cartridge by playing the game; turning off the GB forces you to restart the game completely. Since the cartridge contains no RAM, you cannot save the game's state and restore it for subsequent play.

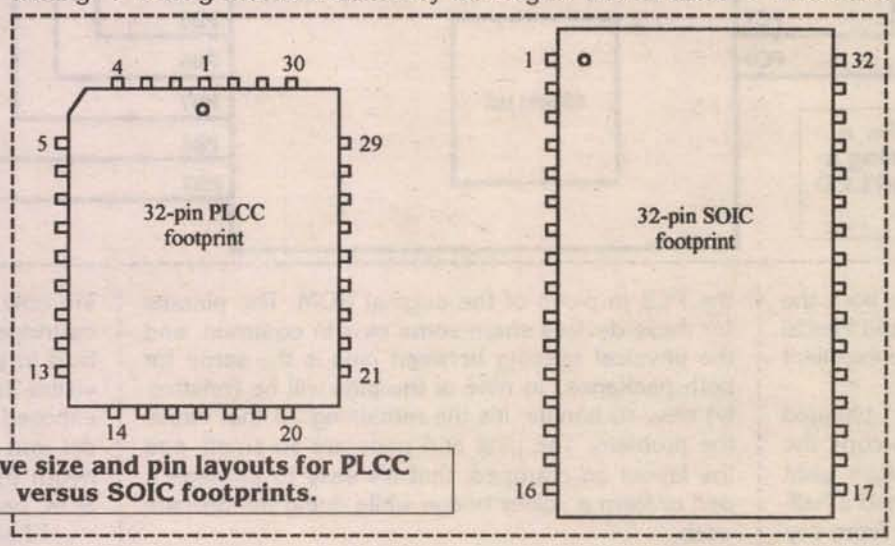
One cartridge format in particular deserves close scrutiny by the robotics community. Cartridges such as Metroid 2 and The Legend of Zelda contain 8K bytes of battery-backed RAM, a memory banking control chip, and a 32-pin ROM. Replacing this ROM with a flash EPROM creates a programmable cartridge capable of holding up to 512K bytes of code and data.

Using a cartridge like Zelda to control a robot requires you to jump several hurdles. First, you need to buy a cartridge with the proper innards. Stores such as Funcoland (I love that name!) sell used GB cartridges at reasonable prices; current price for a Zelda cartridge is about $15.00.

Second, you need to build a device that can read the original Zelda firmware and save it on a PC file, in case you ever want to restore your cartridge's data and play the game again. This same device must also be capable of writing new data into a properly modified GameBoy cartridge. Such devices, called GB reader/writers, are quite simple to build and make a neat weekend project.

Third, you need to buy a 4 MB flash EPROM such as the Advanced Micro Devices' AM29F040. These memory devices go for about $20.00 each from Digi-Key (1-800-DIGIKEY), though you might be able to find them cheaper other places. Be sure you get a chip rated for 150 nsec operation or faster. This speed rating forms part of the dash number of the device. The suffix also contains a letter identifiying the package type and a letter defining the temperature range. Thus, a PLCC part rated for 120 nsec in the commercial temperature range carries a part number of AM29F040-120JC. This is the memory chip that you will install in your Zelda cartridge, after you first remove the existing ROM with its pre-burned Zelda code. Adding this memory chip is by far the most difficult part of the project; later in this article, I'll provide you with some tips and tools that should make the job easier.

Finally, you need software to drive your GB reader. I'm using a tool called ReadPlus, available at various sites on the Internet, for this purpose. ReadPlus can also write data to a GB cartridge that you have modified as described above.



Relative size and pin layouts for PLCC versus SOIC footprints.

Doing the hack

I spent several days researching the steps necessary to perform this GB cartridge hack. First off, I needed a 3.8 mm security bit, used to remove the tamper-proof screw that holds a GB cartridge together. I ordered this from MCM Electronics (1-800-543-4330) for $3.49 (P/N 22-1145). At the same time, I ordered some Nintendo GameBoy connectors — the 32-pin devices that you plug a game cartridge into. These cost about $3.00 each in quantities of five (P/N 83-2285).

Next up was the GB cartridge reader. There are at least five different systems in use for reading and writing modified GameBoy cartridges. Two of them require PC-internal cards, which I decided to avoid. The other three make use of the PC's printer port for transferring data. Of these three, I opted to use Pascal Felber's CARTIO system. The schematic is straightforward, using just six chips, and provides all the functionality I need. Refer to the accompanying schematic, which I've reworked from Pascal's original.

The GB cartridge expects to have a microcontroller driving the eight data lines and 16 address lines on the cartridge's connector. Creating these signals from a PC's printer port requires some latches and a multiplexer. As you can see in the schematic, the board uses three 74hc574 latches, controlled by a single 74hc138 data mux, to derive the address and data output lines from the eight printer data lines on the DB-25 connector. The data input lines require additional handling, as the line printer port only has four inputs. The two halves of a 74hc244 split the eight data lines into two four-bit nybbles, compatible with the four input lines available on the printer port. Reading a byte of data thus requires two operations: one reads the lower four bits of a byte, and another operation reads the higher four bits. Finally, the 74hc00 creates the various gating and control signals needed to exchange data with the cartridge.

I decided to build my CARTIO hardware on a standard Radio Shack experimenter's board (276-158A), using wirewrap techniques. I thought about doing a printed circuit board (PCB), but I only need one and — if necessary — it's usually easier to rework a WW board than a PCB.

The first problem I hit involved the 32-pin GB connector. Naturally, it uses some weird metric, staggered pinout, which didn't fit in the 0.1-inch grid of the Radio Shack board. But such problems are trivial to any hacker with a Dremel tool. I marked a suitable rectangle on the experimenter's board outlining the area where I wanted the pins to fit, chucked a cutting wheel into the Dremel, donned my protective goggles, and went at it. With just a few minutes of careful work, I had cut the needed clearance for the GB connector pins.

ALWAYS wear eye protection whenever you use a Dremel or any other electrical cutting tool. The Dremel cutting bits turn at very high speeds and can shatter during use, flinging shards in all directions. I've already had one cutting disc snap on me, and the goggles probably saved at least one eye.

Next, I used the Dremel and a sanding disc to remove the alignment projections on the underside of the connector, near the mounting holes. This left a completely smooth surface, allowing me to mount the connector flat to the wirewrap board. Finally, I marked and drilled two 3/32nd-inch holes in the wirewrap board, ran a couple of 2-56 screws through the mounting holes in the GB connector, and bolted the connector to the board.

I collected the various WW sockets I would need for the project: four 20-pin, one 16-pin, and one 14-pin. I also needed a connector for hooking the board to the PC's printer port. After some thought, I decided to install a 26-pin dual-row IDC male header on my wirewrap board, rather than use a DB-25 connector. I decided to leave the DB-25 on the end of a ribbon cable because I wanted some flexibility in how I mounted the board into a box. Wiring the DB-25 directly to the board would have cut down my construction options.

I also chose to leave off the small 7805 power supply shown in the schematic, instead using a two-pin male locking connector for external power. This lets me run the board from a bench supply, or from a small power supply that I might choose to put inside the final enclosure with the board. I did leave some extra room on the wirewrap board, should I change my mind and decide to add the 7805 circuitry later.

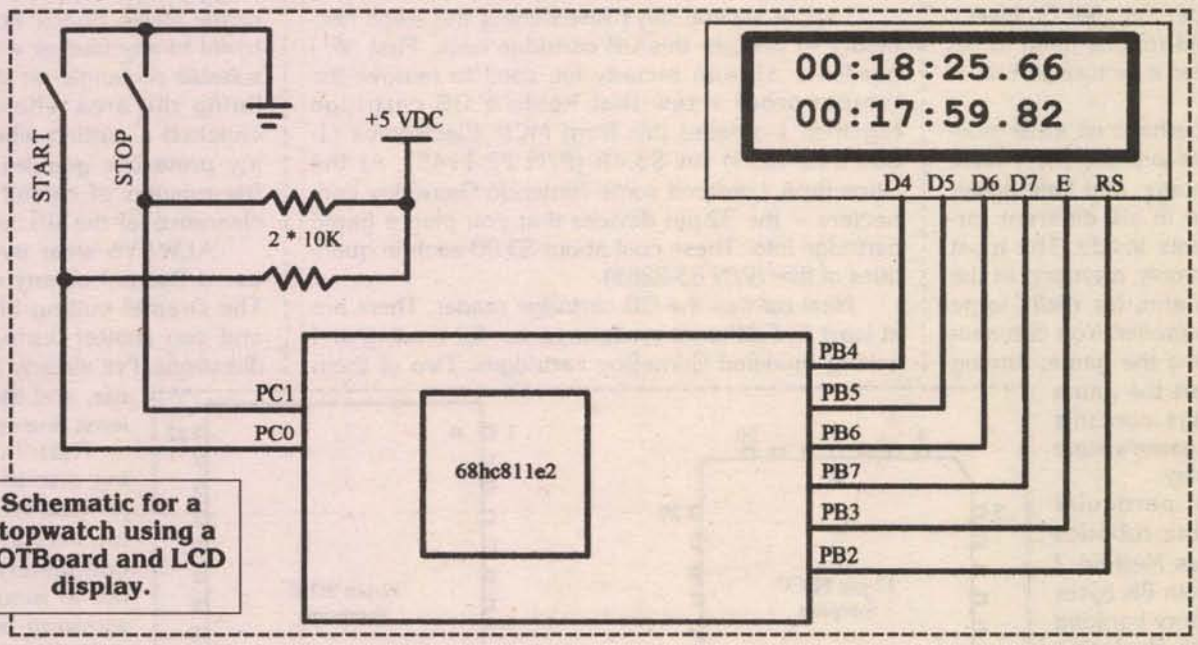
With all the parts in hand, I sat down and began the construction. I've always rather liked wirewrapping. For me, it is like knitting or painting is to other people; a way to occupy your hands, create something useful or valuable, and fill the hours. Even

though it's been a while since my last wirewrap project, the board went together easily and, after just a couple of evenings, it was ready to test.

Testing involved software, and for software to drive the CARTIO reader/writer, I chose Reiner Ziegler's ReadPlus utility. This is a DOS-based program that supports several different programming devices, including the CARTIO, and Reiner has built in some nifty features. One that I really like is his test option for wringing out a CARTIO board. I hooked my board to the PC's line printer port, applied +5 VDC to the board, and executed the ReadPlus program using the -t option. This starts a series of tests of the address, data, and control lines in the programmer board. The program first sets the address lines of the GB cartridge connector to a known state, tells you what that state is, then waits for you to check the relevant cartridge pins and confirm. When you're ready to continue, you press a key and the ReadPlus utility sets up to test the data lines. After about 16 different tests, you've wrung out all of the different signals. If your electronics check out with ReadPlus, they will very likely work.

Naturally, I couldn't resist tinkering with either the software or the hardware on this project. For the electronics, I substituted 74hc574s for the original 74hc374s. This makes for an easier layout should you decide to design a PCB from my schematic. Changing the software was also trivial, since Reiner was kind enough to distribute the C source for his ReadPlus utility; thanks, Reiner! I cleaned up a bug in the -a option that prevented me from analyzing a GB cartridge without specifying a file name.

Regarding the testing, I added code to let me break out of the testing early, by pressing the ESC key. I also changed the output pattern from all 0s or all 1s to patterns of alternating 0s and 1s. These patterns make it easier to find wiring errors involving shorted data or address lines. But my changes to both the electronics and the software were minor, and Pascal and Reiner are to be congratulated for the excellent tools they have created.



Schematic for a stopwatch using a BOTBoard and LCD display.

After I finished testing my GB reader, I plugged in a Zelda cartridge and told ReadPlus to copy the cartridge into a PC file. The read operation went very quickly and, in less than a minute, I had a half-meg binary file containing the firmware from my Zelda cartridge. I had used my large PC for this operation, but I wanted to try reading a cartridge using my laptop PC. I installed ReadPlus on the laptop, hooked up the reader to the laptop's printer port, and gave it a whirl. Despite repeated tries, I was not able to read the Zelda game cartridge on my laptop.

I decided that the problem likely lay with the laptop's printer port, specifically the four input lines used to read data. I added a 22K pull-up resistor to each of these lines (J1-10 through J1-13), and subsequent read operations improved, but still aren't perfect. I haven't added those pull-up resistors to the schematics, since I didn't need them on my big machine, but remember that you might need to include them if you cannot get the reader to work.

One more word on getting the cartridge reader running. If you have problems and decide to use the test feature of ReadPlus, be sure that you check the voltages on the connector pins using a voltmeter, not a logic probe. Pins that should be at a logic 1 should show at least 4.8 VDC, while pins that should be at logic 0 should read no more than 0.3 VDC. Wiring errors — such as shorts between two pins — can produce a voltage that is not a valid logic level. This will fool a logic probe, which cannot display an indeterminate state. Take the extra step in your testing and use a voltmeter.

The big one

I now had three of the four hurdles behind me. All that remained was hacking my Zelda cartridge by removing the original ROM and replacing it with a 4 MB flash EPROM. Full of confidence, I opened up my Zelda cartridge, pulled out my AM29F040 flash, and took a look at the task ahead. This wasn't going to be easy. The original ROM has a 32-pin SOIC outline, made of two rows of 16 pins spaced 0.5 inches apart. Even assuming I could remove the original ROM without damaging the fragile PCB below it, I still had the problem of soldering the flash, housed in a rectangular PLCC package, into the SOIC form factor.

Just for grins, I scanned the GameBoy web sites to see how others had done this same task. Two people had posted pictures of their work. In both cases, they had soldered the PLCC device onto the PCB in place of the original ROM. The pinouts for these devices share some pins in common, and the physical spacing between pins is the same for both packages, so nine of the pins will be (relatively) easy to handle. It's the remaining 23 that cause the problem. The pins and pads are so small, and the layout so cramped, that it's easy to damage a pad or form a solder bridge while doing the delicate work.

I enlisted the aid of a technician at work to help me remove the original ROM. Using the proper surface-mount tools makes all the difference in the world, and he pulled the device without damaging the underlying artwork at all. If you don't have access to such equipment or help, I can offer a few pointers. Since you don't need to preserve the original ROM (you already have a copy, after all), use fine-tipped diagonal cutters to snip each lead of the ROM, cutting the ROM package free from its leads. NOTE: Be sure you snip only one lead at a time! If you try to rush the job and cut more than one lead at the same time, the twisting force will rip a pad off of the board and you will get to buy another cartridge.

After you have cut all the pins and removed the ROM's package, stick the bottom half of the game cartridge shell to your work surface, using a piece of double-sided foam tape no more than 1/4" wide. This makes a great clamp, and the PCB rests neatly inside the plastic shell. Do not apply the foam tape to the PCB itself, as you will risk ripping some of the artwork off of the board when you try to peel the board free from the tape.

With the PCB reasonably secure, reduce the temperature of your soldering iron to 600 degrees or so. You will need a very fine tip for the unsoldering phase, and you will need to keep the tip very clean. Carefully apply the iron's tip to a solder pad, then use a long needle or probe to lift the broken pin from the pad. Take care not to overheat the pad, as this will lift the pad and ruin your board. Repeat the procedure until you have removed all the cut pins from the PCB. Use a high grade of solder wick to clean up any solder bridges left behind.

Now you should have a cleaned cartridge PCB, ready to accept your flash ROM. As I mentioned before, one technique you can use involves soldering the flash to as many of the correct pins as possible, then using short runs of stripped wirewrap wire to connect the remaining pins. This is quite tedious and error-prone, but if you have the time and dexterity, you can make it work. As always, use as little heat as possible on the pads so you don't damage the board.

A variation of this technique takes advantage of the similarity in the pinouts of the PLCC and SOIC footprints. Working carefully, you can align the PLCC package on top of the SOIC pattern, twisting the PLCC package slightly off alignment. Done properly, this lets you get almost half of the pins touching the correct pattern, minimizing the soldering you have to do.

Given my level of mechanical skill, I tried another path. I used Autotrax, my favorite PC board layout tool, to design a small PCB that adapts a PLCC pad layout to an SOIC pad layout. The top layer of this tiny SMT circuit board contains the layout for the flash EPROM. Each pin of this pattern is routed, using vias and fine traces, to the corresponding pad of an SOIC outline on the bottom layer of the board. The pads for the SOIC outline are only half the length of the pads on a GameBoy cartridge. When the PCB is properly cut to size and held in place, half of each SMT pad of the PCB is visible from underneath the adapter board. These exposed pads give you enough room to touch a solder iron tip; the melted solder will then wick underneath the adapter board to the matching smaller SOIC pad, forming an electrical connection.

I had several boards made by Alberta Printed Circuits, and Dan Mauch — one of the Seattle Robotics Society's machinists — kindly cut one of the PCBs to exactly the proper size. Soldering this board into place was much simpler than trying to do the procedure described above, and I like the looks of the finished product. Unfortunately, the adapter board adds .062 inches of height; throw in the extra height of the PLCC flash chip and the PCB was so thick that I could not put the plastic shell back together. This took only a few minutes to solve, thanks to my trusty, dusty Dremel tool.

Whether you use the hand-wiring method or an adapter board similar to the one I built, two pins on the original layout require special handling. Do not connect pin 1 of the flash to pin 1 of the ROM, and do not connect pin 31 of the flash to pin 31 of the ROM. Instead, connect pin 1 of the flash to pin 31 of the ROM layout. Then use short lengths of wirewrap wire to connect one end of a 47K resistor to pin 31 of the flash and to pin 31 of the GameBoy connector. This latter connection can be made by exposing

1/8th inch of bare wire, then carefully tacking the wire directly to the finger of pad 31 on the connector. Use as little of the gold contact as you possibly can, and be careful not to create a solder bridge to nearby vias or pads. Finally, connect the remaining end of the 47K resistor to any trace on the board connected directly to Vdd. Be sure to use an ohmmeter to verify that the trace you want to use is actually connected directly to Vdd.

I have not included the artwork for my board in this article, because I had a layout error that needs fixing. I probably won't get around to fixing it, though, since I already have all the adapter boards I need. You should have enough information here to design your own adapter, if you like. Note that there isn't a lot of available room on the adapter board, and I had to use 8/8 design rules with 20 mil via holes to squeeze in all of the circuitry.

After I finished the wiring and cleaned up the residue from my Dremel work, I was ready to try programming my new GB cartridge. Using the -p option of ReadPlus, I was able to write my previously saved Zelda game into my flash cartridge. I then used ReadPlus' -a option to analyze the file in the cartridge; the analysis confirmed that the flash cartridge now contained the Zelda program, and that the cartridge's checksum was correct. I plugged the flash cartridge into a real GameBoy, turned it on, and spent a few minutes playing Zelda.

Though this hack involved some tedious work, I think the possibilities it opens up are worth the effort. I have a programmable cartridge capable of holding up to 512 KB of code, complete with a sophisticated banking scheme, all in a compact and rugged form factor. Although my tests involved GameBoy code, there is no reason why I couldn't add a 32-pin GameBoy connector to an expanded 68hc11 board and use the GB cartridge as a memory device for the 'hc11. The GB cartridge only supports an eight-bit data bus, so using it for a larger processor — such as a 68332 — wouldn't be effective. Still, a lot of projects only need an eight-bit processor, and putting that code into a tiny GB cartridge makes sense.

The above discussion only skims the surface of this project, and I encourage you to tap into the GameBoy Developers' Ring on the Internet, and sift through the tons of valuable information on the GameBoy.

It's in the timing

I watched a lot of Olympics in February, all of it broadcast by the Canadian Broadcasting Corporation (CBC), which did an excellent job covering the event. Sports such as downhill skiing, speed skating, and bob-sleigh (as the Canadians call bobsledding) all require timing, and the results are usually displayed to the nearest hundredth of a second. As I watched these events, I thought about the various contests held by the Seattle Robotics Society, notably the upcoming Fire-Fighting contest.

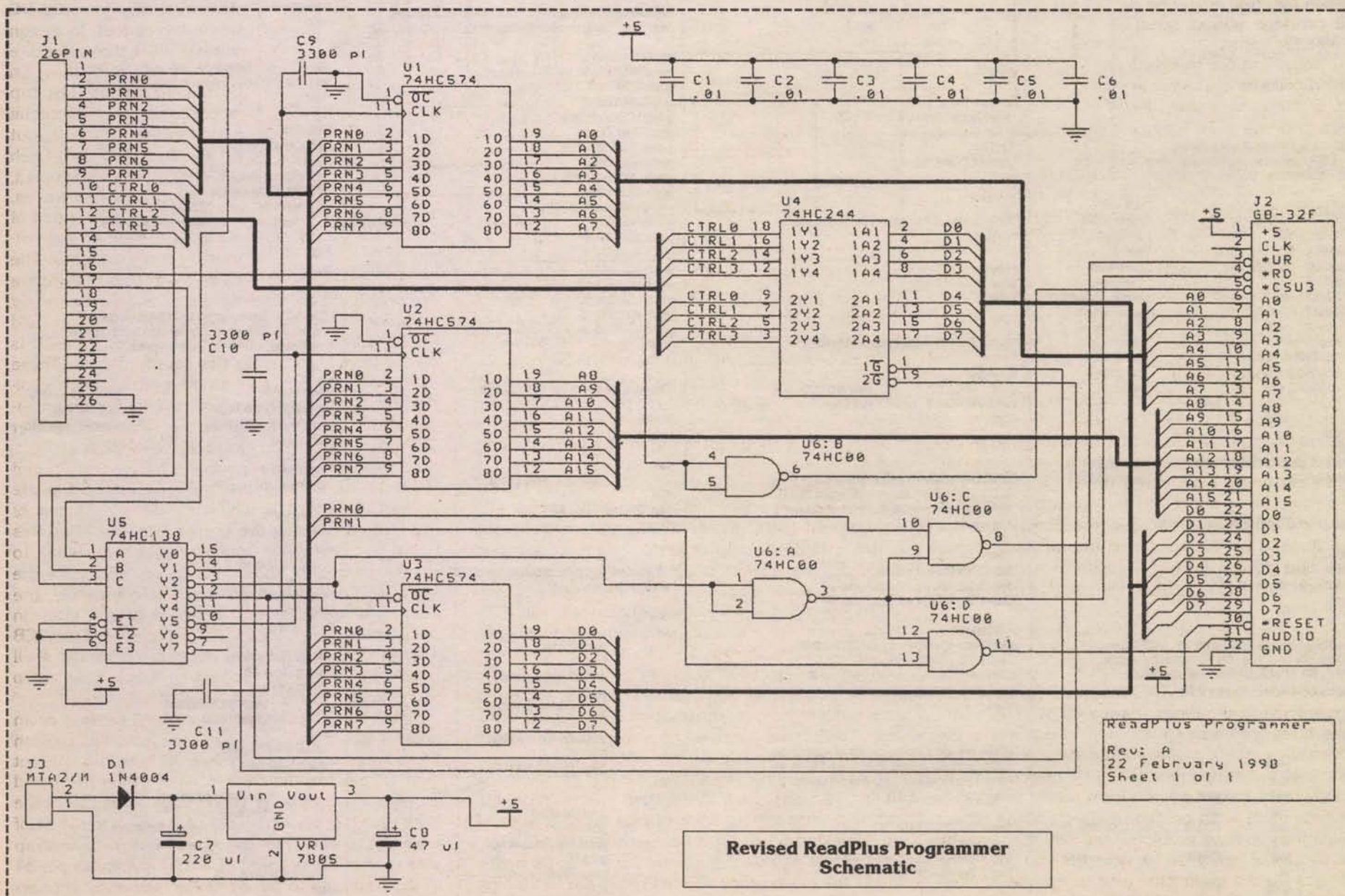
For some reason, the actual timing of our events is always left to the last minute. Immediately before the contest starts, someone remembers that we need a timekeeper. A loud cry goes up for Frank Haymes, an SRS stalwart who carries a multi-function digital that can act as a stopwatch. Frank then gets pressed into service as a timer, since he owns the watch. Despite the fact that Frank always does a first-rate job as a timekeeper, I've always worried about the haphazard way we handle this important function. After all, Frank is only human, and one day he may have to miss a meeting due to some emergency or suchlike. Then what will we do for a stopwatch and a timekeeper?

So one evening, during the Olympics, I sat down and wired up a BOTBoard to act as a digital timer. The circuitry is ridiculously simple, little more than an LCD display and a couple of switches. Refer to the accompanying schematic.

I won't bore you with the details of driving an LCD using the 68hc11; I've covered that topic countless times in these pages already. I just used port lines PB2 through PB7 to create a four-bit latch and control lines for driving the display. PB2 acts as the register select, for choosing writes to either the data or command registers, while PB3 provides the E signal for latching data during transfers to the LCD. PB4 through PB7 serve as data lines D4 through D7 to the LCD.

The accompanying SBasic code shows how easy it is to make a 2x16 character LCD act as a stopwatch. This code maintains two four-word arrays — CLOCK0 and CLOCK1 — and displays the values in each on separate lines of the LCD. When the user presses the START button, hooked to PC0, the stopwatch code copies the time value in CLOCK0 to CLOCK1, then enables the 68hc11's timer TOC5 to begin counting at a rate of 100 counts per second. The interrupt service routine (ISR) for TOC5 uses each interrupt to increment the various elements of CLOCK0 to provide a clock timer with a maximum value of 24 hours.

While the clock is running, the code shows the value in CLOCK0 on the top line of the display and the value in CLOCK1 on the bottom. Though CLOCK0 is incrementing once each 1/100th of a



Revised ReadPlus Programmer Schematic

second, the display is updated less frequently, so you see a clock value that changes about four times a second. However, the real time value, kept in CLOCK0, is always accurate to 1/100th of a second. When the user presses the STOP button, tied to PC1, the code freezes CLOCK0 and updates the display one more time. Now the code sits in a loop, waiting for the user to press the START button again.

One element of this code shows a powerful feature of SBasic. I've used the ASMFUNC statement to override SBasic's normal _OUTCH function. Usually, SBasic uses a library version of _OUTCH to send a single character to the SCI. By overriding this function, I can use my own _OUTCH routine to send that character to the LCD. This means that all of the console output statements, such as PRINT, now send their output directly to the LCD.

Note that the code listed here has a small bug in it. The TOC5 interrup — responsible for updating the clock values — is active before the code copies the value of CLOCK0 to CLOCK1. Thus, occasionally the value that appears on the bottom line of the display will have bumped by one count from the value previously displayed on the top line. I'll leave the simple fix for this problem to those enterprising readers who want to try out this code.

I spent a couple of evenings wiring up the electronics and putting it in a Radio Shack project box. The design lends itself to timing many different types of events. If you drill holes and mount a pair of RCA phono jacks on the front panel, then wire jacks in parallel with both the START and STOP switches, you get a stopwatch that can use external switch closures to start and stop timing intervals. This can come in very handy for soapbox derby races or other fast events where the time crossing a finish line is important. You can also add code to support more than one clock array and change the behavior of the STOP button code, to build a stopwatch timer that can track multiple legs of multiple racers.

This is one of those simple but useful projects that can mutate in many directions. Spend some time going over the code to get a feel for how the 68hc11 and SBasic work together to create a high-resolution timer. Then add your own ideas to turn this simple stopwatch into the right tool for your club's contests. Now, where did I put that Fire-Fighting contest robot? **NV**

As always, you can reach me at:

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```
'
' stopwtch.bas  event stopwatch for 68hc11 and 2-line LCD
'
include "regs11.lib"
asmfunc                 _outch          ' replace _OUTCH
declare lcdtimer
declare wait
declare clock0(4)                       ' clock 0
declare clock1(4)                       ' clock 1
declare n
declare stopped

const DLY100s = 20000                   ' delay for 1/100th sec
'
' ISR to handle the 4.1 msec tic counter.
' This ISR decrements WAIT and LCDTIMER
' until either reaches 0, then rearms
' itself.
'
interrupt $fff0                         ' RTI
if wait <> 0
        wait = wait - 1
endif
if lcdtimer <> 0
        lcdtimer = lcdtimer - 1
endif
pokeb tflg2, %01000000
end

'
' ISR to count hundredths of a second.
' This ISR automatically updates the values
' in the clock0 array, then rearms itself.
'
interrupt $ffe0                         ' toc5 ISR
clock0(3) = clock0(3) + 1               ' bump 1/100s
if clock0(3) > 99                       ' if overflow...
  clock0(3) = 0                         ' zero it
  clock0(2) = clock0(2) + 1             ' bump secs
  if clock0(2) > 59                     ' if overflow...
    clock0(2) = 0                       ' zero it
    clock0(1) = clock0(1) + 1           ' bump minutes
    if clock0(1) > 59                   ' if overflow...
      clock0(1) = 0                     ' zero it
      clock0(0) = clock0(0) + 1         ' bump hours
      if clock0(0) > 23                 ' if overflow...
        clock0(0) = 0                   ' zero it
                        endif
                endif
    endif
endif
poke toc5, peek(toc5) + DLY100s         ' set next time
pokeb tflg1, $08                        ' clear toc5 flag
end
'
' wait until LCDTIMER variable reaches 0
'
WaitLCD:
lcdtimer = pull()
do loop until lcdtimer = 0
return

'
' Assembly-language replacement for _OUTCH low-level
' routine. This version of _OUTCH writes a character
' to the LCD. All calls to PRINT and other SBasic
' display routines will now write to the LCD.
'
asm
PORTB   equ     $1004
_outch
        pshb
        ldab    PORTB
        andb    #$07
        orab    #$07
        stab    PORTB           rs=1, e=0, msb=0
        orab    #$0f
        stab    PORTB           rs=1, e=1, msb=0
        tab
        andb    #$f0
        orab    #$0c
        stab    PORTB           rs=1, e=1, data
        andb    #$f4
        stab    PORTB           rs=1, e=0, data
        ldab    PORTB
        andb    #$07
        orab    #$07
        stab    PORTB           rs=1, e=0, msb=0
        orab    #$0f
        stab    PORTB           rs=1, e=1, msb=0
        tab
        lslb
        lslb
        lslb
        lslb
        andb    #$f0
        orab    #$0c
        stab    PORTB           rs=1, e=1, data
        andb    #$f4
        stab    PORTB           rs=1, e=0, data
        ldd                     #$100
out1
        subd    #1
        bne     out1
        pulb
        rts
endasm

'
' Move to start of second line on LCD
'
NewLine:
gosub LCDCmd, $c0
return

'
' Move to start of first line on LCD, do not clear
' display.
'
Home:
gosub LCDCmd, $80
return

'
' Clear LCD, then move to start of first line.
'
ClearLCD:
gosub LCDCmd, 1                 ' clear and home LCD
gosub WaitLCD, 2                ' wait a bit
return


'
' LCDDataN sends the top four bits of a char to the
' LCD's data register. This routine toggles the RS
' and E lines as needed to time the transfer, using
' four writes to port B.
'
' Step 1: Set RS=1, E=0
' Step 2: Set RS=1, E=1
' Step 3: Set RS=1, E=1, data to bits 4-7
' Step 4: Set RS=1, E=0, data to bits 4-7
'
LCDDataN:
pokeb portb, ((peekb(portb) and $07) or $07)
pokeb portb, peekb(portb) or $0f
pokeb portb, peekb(portb) or ((pull() and $f0) or $0c)
pokeb portb, peekb(portb) and $f4
return

'
' LCDCmdN sends the top four bits of a char to the
' LCD's command register. This routine toggles the
' RS and E lines as needed to time the transfer,
' using four writes to port B.
'
' Step 1: Set RS=0, E=0
' Step 2: Set RS=0, E=1
' Step 3: Set RS=0, E=1, cmd to bits 4-7
' Step 4: Set RS=0, E=0, cmd to bits 4-7
'
LCDCmdN:
pokeb portb, peekb(portb) and $03
pokeb portb, peekb(portb) or $08
pokeb portb, peekb(portb) or ((pull() and $f0) or $08)
pokeb portb, peekb(portb) and $f0
return

'
' LCDCmd sends a byte to the LCD's command register,
' using two calls to LCDCmdN.
'
LCDCmd:
gosub LCDCmdN, pick(0)          ' send the top nybble
place 0, lshft(pick(0))         ' move low nybble to
top
place 0, lshft(pick(0))
place 0, lshft(pick(0))
place 0, lshft(pick(0))
gosub LCDCmdN, pull()           ' send the low nybble
return

'
' InitLCD sends a string of commands to the LCD following
' power-up. Timing between commands is done with WaitLCD.
'
InitLCD:
gosub WaitLCD, 10
gosub LCDCmdN, $30
gosub WaitLCD, 2
gosub LCDCmdN, $30
gosub WaitLCD, 2
gosub LCDCmdN, $30
gosub WaitLCD, 2
gosub LCDCmdN, $20
gosub WaitLCD, 10
gosub LCDCmd, $28
gosub WaitLCD, 10
gosub LCDCmd, 8
gosub WaitLCD, 10
gosub LCDCmd, 1
gosub WaitLCD, 10
gosub LCDCmd, 6
gosub WaitLCD, 10
gosub LCDCmd, 12
return

'
' Display a number as two decimal digits.
'
Print2d:
if pick(0) < 10
        outch '0'
else
        outch '0' + (pick(0) / 10)
endif
outch '0' + (pull() mod 10)
return

'
' Display time on top line or bottom line of LCD,
' depending on argument.
'
ShowTime:
if pick(0) = 0
        gosub Home
        print " ";
        gosub Print2d, clock0(0)
        outch ':'
        gosub Print2d, clock0(1)
        outch ':'
        gosub Print2d, clock0(2)
        outch '.'
        gosub Print2d, clock0(3)
endif
if pull() = 1
        gosub NewLine
        print " ";
        gosub Print2d, clock1(0)
        outch ':'
        gosub Print2d, clock1(1)
        outch ':'
        gosub Print2d, clock1(2)
        outch '.'
        gosub Print2d, clock1(3)
endif
return

'
' Wait for the user to press the Start switch. The
' logic includes a 40 msec debounce delay, using variable
' WAIT.
'
WaitForStart:
do
        waitwhile portc, $01            ' wait until pc0 goes
low
        wait = 10
        do loop until wait = 0
loop while peekb(portc) and $01 = $01
poke toc5, peek(toc5) + DLY100s
pokeb tflg1, $08                        ' clear TOC5 flag
pokeb tmsk1, $08                        ' allow TOC5 interrupts
stopped = 0
return

'
' See if the user pressed the Stop switch. The logic
' includes a 40 msec debounce delay, using variable
' WAIT.
'
CheckForStop:
if peekb(portc) and $02 = 0
  wait = 10
  do loop until wait = 0
  if peekb(portc) and $02 = 0
    pokeb tmsk1, $00    ' disable TOC5 interrupts
    stopped = -1        ' show clock is stopped
  endif
endif
return

'
' The main program. Set up the interrupts, clear
' the two clock arrays, wait for the Start switch, update
' the displays, and wait for the Stop switch.
'
main:
pokeb ddrc, $fc                         ' pc0 & pc1 = inputs
pokeb tflg2, %01000000                  ' clear RTI flag
pokeb tmsk2, %01000000                  ' allow RTI interrupts
interrupts on
for n=0 to 3
  clock0(n) = 0
  clock1(n) = 0
next
gosub InitLCD
print " Stopwatch 1.0";
wait = 500
do loop until wait=0
gosub ClearLCD
print " Press START";
gosub NewLine
print "  to begin";
do
  gosub WaitForStart
  gosub ClearLCD
  for n = 0 to 3
        clock1(n) = clock0(n)
        clock0(n) = 0
  next
  gosub ShowTime, 0
  gosub ShowTime, 1
  do
        gosub CheckForStop
        if wait = 0
                gosub ShowTime, 0
                wait = 60
        endif
  loop until stopped <> 0
loop
end
```

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Software Wizardry

Webcasting

By Harry Helms

There is a seemingly unlimited amount of information available on the World Wide Web. And that means it's tough keeping up-to-date with new material and changes to your favorite Web sites. You can bookmark your favorite sites in your Web browser, but you still have to "manually" check each of those sites occasionally for new material and changes. If a site contains several pages, finding the page(s) where the new or altered material appears can take a lot of time and effort ... so much so that it's often not worth the effort to try to keep up with such changes.

On the other "end" of the Web, developers would like some way to cut through the clutter on the Web and alert earlier visitors when new material is available on a site. The motivation is more than kindness on the part of Web developers; advertisers would pay premium prices for space on pages that are sure to reach earlier visitors.

The dream for many Web developers has been to create a system that alerts Web site visitors when new or updated content is available or – better yet – automatically deliver such pages to visitors who want to receive them. This has become known as push technology, or webcasting. Several different push technologies have been developed, but now we are at the point where webcasting is becoming simple enough to implement on almost any Web site. This means you no longer have to rely upon visitors to re-visit your site for new content; you can instead "mail" them new content and pages as you develop them.

This has a lot of potential for Web users and developers. This month, we'll take a look at how to implement webcasting on your Web site.

Early Efforts

The potential of webcasting was recognized soon after the Web became popular. Two popular methods were developed by PointCast and BackWeb.

The PointCast system requires users to download and install the PointCast software on their PC. Users fill out registration forms with PointCast or PointCast-equipped Web sites to indicate what type of information the user wants to receive. When updated information is made available by PointCast or participating Web sites, it is downloaded to the user's PC "in the background." This means the material is automatically downloaded even while the PC is visiting another Web site. The downloaded material is displayed as a screen saver whenever the PC is not being used for a task.

BackWeb works in a similar fashion, but it indicates when new content has been received by placing a small icon on the user's monitor display. Users click on the icon to display the new material.

While useful, technologies like PointCast and BackWeb have some obvious limitations. You have to install new software on your PC. You are limited to the sites supporting these technologies. And you don't have control over how the updated material is delivered or displayed.

PointCast, BackWeb, and similar push technologies are "plug-ins" for popular Web browsers like Netscape and Internet Explorer. It was natural that Netscape and Microsoft would add push technologies to upgrades of their browsers. And that's just what they did.

Netscape's Netcaster

Netscape incorporated a push technology called Netcaster in the latest version of their Communicator browser released in late 1997. Netcaster was designed to take advantage of the huge advantage Netscape enjoyed in browser usage prior to 1997.

The default Web site for Netscape's browsers is, not surprisingly, www.netscape.com. This meant that Netscape's Web site was the most visited spot on the Web until 1997. Netcaster was intended to work with Netscape's Web site, and deliver updated material to visitors who used Netcaster-enabled Netscape browsers.

Netcaster is a pure Java application, meaning it can work in recent versions of the Netscape and Microsoft browsers. "Channels" on the Netscape site use Java, JavaScript, and HTML, and are delivered to users through Netscape.

Netcaster was intended as a way to sell "channel space" on Netscape's Web site, not as a general-purpose Web push technology. Netscape managed to conclude deals with several leading media companies – such as Disney – to provide content for its various channels. However, Netscape apparently did not anticipate the rapid adoption of Microsoft's competing Internet Explorer and the rise of search engines such as Yahoo and Excite. Netscape experienced some delays in getting Netcaster ready, allowing Microsoft's competing Active Channel technology to gain a foothold. As a result, Netcaster is being repositioned as a general-purpose push technology.

Unfortunately, creating Web sites and channels using Netcaster is not an easy process. Moreover, it works only with sites that have been created for Netcaster. If you want to keep up-to-date on sites that do not use Netcaster, you'll have to bookmark and remember to check them. Finally, buying a channel on the Netscape site takes a lot of money, and to date Netcaster is rarely used beyond the Netscape Web site.

Because of these factors, Netcaster does not seem to be a good choice for webcasting unless you're well-funded enough to buy a channel on the Netscape site. If you're a Web user instead of developer, Netcaster has a lot to offer, however.

Webcasting With Internet Explorer 4.0

Microsoft's Internet Explorer 4.0 browser comes with several features that facilitate webcasting. In fact, IE 4.0 supports a form of webcasting for any Web site, including those that have not been designed to support any form of push technology.

The secret to doing this is IE 4.0's built-in "spidering" capability. A "spider" is a program that searches and indexes the content of a Web page or site. Spiders are used by Internet search engines like Infoseek, Lycos, etc., to index and organize Web pages into different categories. Internet Explorer 4.0's spider searches the content of all bookmarked Web sites, and highlights any bookmarked site where new or changed material is detected. This spidering is done "in the background" by the browser whenever users are on-line, even if they are visiting other Web sites.

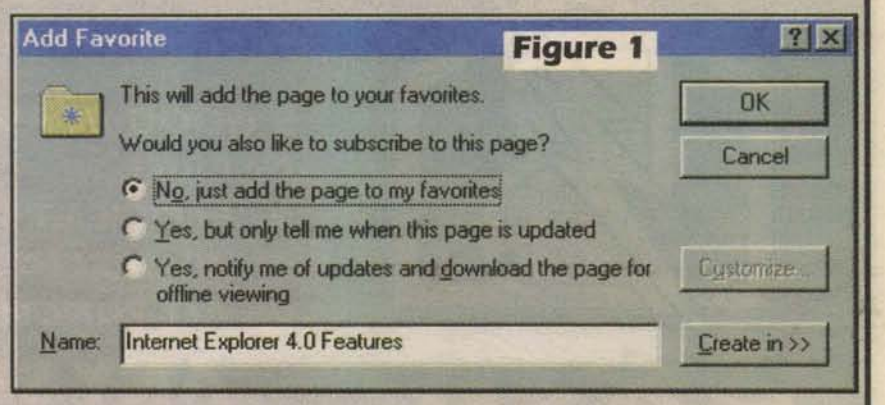
A more powerful form of webcasting with Internet Explorer 4.0 uses the channel definition format (CDF) specification that Microsoft has proposed to the World Wide Web Consortium (3WC). Unlike simple bookmarking, a CDF channel is a collection of frequently updated information. The CDF specification describes the information contained in the channel and when and how it is updated or changed. This allows the spidering process to be timed to when site content is typically updated. CDF also lets you designate which page(s) of a Web site are to be webcast.

CDF is one of the first applications of XML (eXtended Markup Language), the new page authoring language that promises to have a major impact on Web publishing in the near future. See the accompanying sidebar for more information on XML.

Microsoft is using the term Active Channel to describe Web content developed using the CDF specification. Active channel content can be delivered to a user's PC in four ways: full screen mode (that is, an ordinary Web page display); screen saver mode (Web page is displayed while the user's PC is idle); desktop mode (a "mini-page" display like a stock ticker or scrolling marquee); and channel mail mode (pages are delivered to the PC's mailbox).

The process of being notified by Internet Explorer 4.0 when a Web page has new or updated content is called a subscription. I think Microsoft made a mistake by using this term, since it implies that you need to pay money to get the new content. In this context, however, subscribing to a Web site means you simply add it to a list of favorite sites to be inspected by IE 4.0's built-in "spider."

Figure 1 shows the dialog box displayed when you select the "add to favorites" item from Internet Explorer 4.0's "favorites" menu. You have three options. The first just adds, or "bookmarks," the page to your list of favorite Web sites. The second option causes Internet Explorer 4.0 to "spider" the Web site and simply notify you if its finds new or updated content on the site. If this option is selected, a "gleam" will appear next to the item in the list of favorites; you then can go to the site in the usual way. The most interesting new option is the



third one. If this option is selected, Internet Explorer 4.0 will automatically download the page when you're on-line (often when you're viewing another page previously downloaded) and you can view it later.

If a site has been prepared using the CDF format, the dialog box shown in Figure 2 is displayed. A CDF-developed channel is easier and faster for Internet Explorer 4.0 to "spider," since it is XML-based and the DTD for the XML page indicates specifically which sections have been changed. The page can be displayed in various ways on a user's desktop, including as a full screen, as a screen saver, as a desktop item of a desired shape and size, or delivered to the user's E-Mail mailbox. Developers can give users different options as to how they want updated material delivered and displayed.

Like so many things about the Web, I have a feeling we're in the infancy of what will eventually evolve. I wouldn't be surprised in a few years if your subscription to *Nuts & Volts* is delivered via the Web instead of the mail! **NV**

About XML

Hypertext markup language (HTML) is the standard for Web publishing, but it has some real limitations. For example, suppose you want to include some Japanese characters or a mathematical notation on a Web page filled with English text. With HTML, your only solution will usually be to add the new characters or notation as graphics, such as .GIF files, instead of as text.

HTML has shortcomings even for the English alphabet. You're limited in the number of type fonts and sizes you can use, and HTML presents all sorts of formatting problems for laying out text and graphics.

META tags inside HTML documents are used to help search engines like Yahoo and Excite classify and index Web pages, but these are overly broad and limited in the amount of information they can convey. As a result, Web searches are usually much less accurate than most users would like.

The introduction of webcasting has made the limitations of HTML even more crucial. The "spidering" used by Internet Explorer 4.0 (and Web search engines) is not an optimum solution; it would be better if a Web site could somehow "announce" when it had updated content and point out just which pages had changed and not require the entire site to be "spidered."

It so happens that a solution to these problems has existed for several years. It's called standard generalized markup language (SGML) which became an international standard in 1986. SGML was developed as a platform-independent and extremely flexible way to markup text files for publication, and has since been used for everything from typesetting to databases to CD-ROM publishing. If it can be done on a page of printed text or on a video display containing text, it can be done with SGML. In fact, HTML itself is nothing but a subset of SGML.

So why not just use SGML for Web publishing? The big reason is the tremendous "overhead" of SGML. SGML includes many features useful for print, CD-ROM, etc., publishing that are not required for Web publishing and just take up space. The solution to this problem is to select those other elements of SGML that have relevance to Web publishing, add them to HTML, and ignore the rest. A group of SGML experts working with the World Wide Web Consortium (3WC) studied the problem and, in 1997, released a draft specification for eXtended Markup Language (XML). The final specification may be released by the time you read this; it is expected to follow the draft specification very closely.

Perhaps the biggest advantage of XML over HTML is how it will allow easy conversion of existing SGML documents into Web-ready form. Since it was introduced in 1986, SGML has become the standard markup language for books, directories, databases, government documents, and almost any lengthy text document that's stored in digital form. HTML requires extensive reformatting and re-coding to convert from SGML, while XML would involve little more than changing the document type declaration (DTD) that is placed at the start of a SGML/XML document. The DTD describes such things as special characters, fonts and sizes, formatting, etc., used in a document.

Using a DTD means it will be easy to change the "look" of a Web page merely by changing the DTD for that document; you won't have to go through the document and carefully change text, headers, etc. It also means visitors can change how a Web page is displayed by selecting a new DTD in their Web browser. For example, Web users with vision problems could easily change to a large-print version of a Web page by selecting an optional DTD in their browser.

Another interesting aspect of XML is the flexibility of linking it offers. When you click a link on a HTML page, you either go to another section in the same page or to an entirely new page. With XML, it's possible to link to a specific paragraph or even sentence in another document. This means that you could keep a visitor to your site "anchored" there while permitting them to view selected sections of other pages (to see definitions or graphics, for example).

As mentioned in this month's column, CDF is the first use of XML, and so far Microsoft's Internet Explorer 4.0 is the only browser that supports XML. Given XML's many advantages over HTML, expect Netscape to soon incorporate XML in its browsers. (Remember that both HTML and XML are subsets of SGML; adding XML capability to a HTML browser is relatively simple.)

Fortunately, you won't be forced to start using XML immediately. XML is "overkill" for many purposes, especially simple pages. But since XML makes it possible to move so many existing documents to the Web, you can expect the majority of Web sites to be using XML about five years from now.

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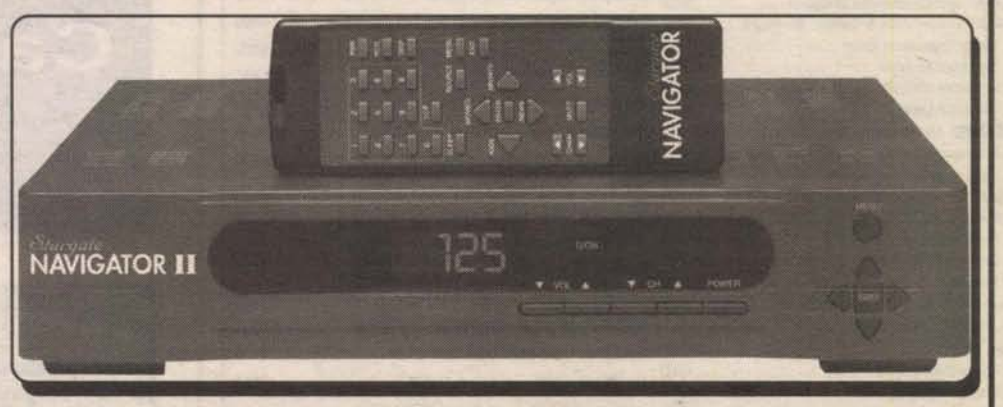

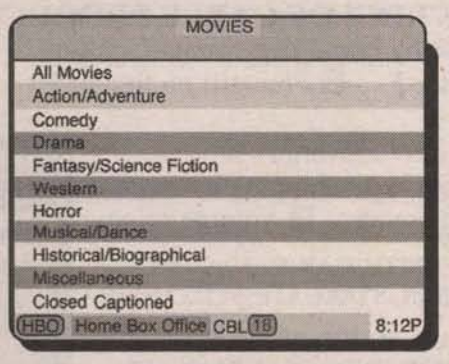

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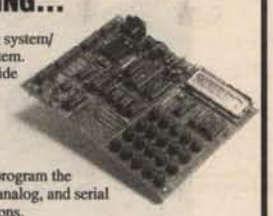

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by Ray Marston

SECURITY ELECTRONICS SYSTEMS AND CIRCUITS — Part 3

Ray Marston looks at contact-operated security circuits in the third episode of this series.

Contact-operated security circuits are units that are activated by the opening or closing of a set of electrical contacts. These contacts may take the form of a simple push-button switch, a pressure-pad switch, or a magnetically-activated reed switch, etc.

The security circuit's output may take the form of some type of alarm-sound generator, or may take the form of a relay that can activate any external electrical device, and may be designed to give non-latching, self-latching, or one-shot output operation.

Contact-operated security systems have many practical applications in the home, in commercial buildings, and in industry. They can be used to attract attention when someone operates a push switch, or to give a warning when someone opens a door or treads on a pressure pad or tries to steal an item that is wired into a security loop, or to give some type of alarm or safety action when a piece of machinery moves beyond a preset limit and activates a microswitch, etc.

A wide range of practical contact-operated security circuits are described in this article.

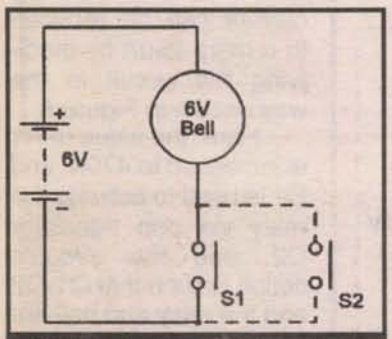

Figure 1. Simple door-bell type close-to-operate alarm circuit.

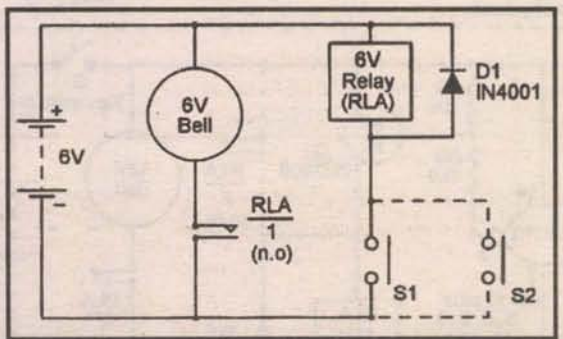

Figure 2. Relay-aided non-latching close-to-operate alarm.

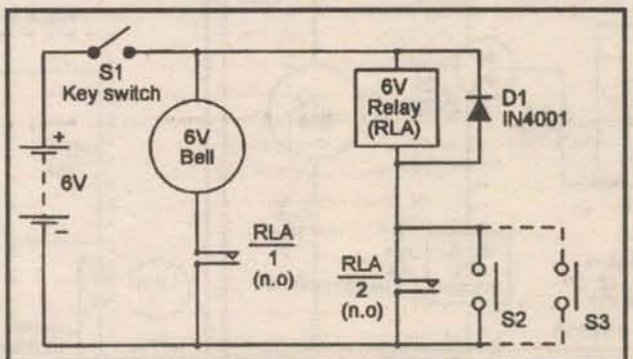

Figure 3. Relay-aided self-latching close-to-operate security alarm.

BELL AND RELAY-OUTPUT CIRCUITS

CLOSE-TO-OPERATE CIRCUITS

The simplest type of contact-operated security circuit consists of an alarm bell (or a buzzer or electronic 'siren-sound' generator, etc.), wired in series with a normally-open (n.o.) close-to-operate switch; the combination being wired across a suitable battery supply, as shown in the basic 'door-bell' alarm circuit of Figure 1.

Note that any desired number of n.o. switches can be wired in parallel, so that the alarm operates when any of these switches are closed. This type of circuit gives an inherently non-latching type of operation, and has the great advantage of drawing zero standby current from its supply battery.

A disadvantage of the basic Figure 1 circuit is that it passes the full 'alarm' current through the n.o. operating switches and their wiring, so the switches must be fairly robust types, and the wiring must be kept fairly short if excessive wiring volt-drops are to be avoided. This latter point is of particular importance in security applications in which the circuit is used with several widely separated n.o. switches.

The solution to this problem is to activate the bell, via a 'slave' device (which is fitted close to the bell but requires a fairly low input current), and to activate this slave device (and thus the bell) via the security switches. Figures 2 to 6 show a variety of such circuits, in which the slave device takes the form of a relay, a power transistor, or an SCR.

Figure 2 shows a relay-aided version of the close-to-operate alarm circuit. Here, the parallel-connected n.o. switches are wired in series with the coil of a 6V relay (which typically draws an operating current of less than 100mA), and the relay contacts (which can typically switch currents of several amps) are wired in series with the alarm bell, and both combinations are wired across the same 6V supply.

Thus, when the switches are open, the relay is off and its contacts are open, so the bell is off, but when any one or more of the switches are closed, the relay is driven on and its contacts close and activate the alarm bell. Note in the latter case that the switches and their wiring pass a current equal to that of the relay coil; the switches can thus be fairly delicate ones, such as sensitive reed types, and the wiring can be reasonably long. Silicon diode D1 is wired across the relay's coil to protect the switches against damage from the coil's switch-off back EMF.

The Figure 2 circuit gives a non-latching form of operation, in which the alarm operates only while one or more of the operating switches are closed.

In most high-security applications, the circuit should be a self-latching type in which the relay and alarm automatically lock on as soon as any one of the n.o. switches is closed, and can only be de-activated via a security key.

Figure 3 shows the above circuit modified to give this type of operation. Here, the relay has two sets of n.o. contacts, and one of these is wired in parallel with the n.o. switches so that the relay self-latches as soon as it is operated, and the entire circuit can be enabled or disabled/de-activated via key switch S1, which is wired in series with the battery supply line.

Circuits of this basic type are usually used in low-cost 'zone protection' applications, in which the 'zone' is a large room or shop floor, the S1 key switch is located outside of the zone, and the n.o. trigger switches are hidden pressure-mat switches or door- or window-operated microswitches fitted within the protected zone.

An alternative solution to the Figure 1 switch-and-wiring 'current' problem — but which can only be used in non-latching applications — is shown in Figure 4, in which npn power transistor Q1 is used as the slave device. Resistor R1 ensured that — when any of the activating switches are closed — Q1's drive curent is limited to less than 60mA, which (assuming that Q1 has a nominal current gain of at least x25) enables the transistor to switch at least 1.5A through the alarm bell.

Another solution to the 'current'

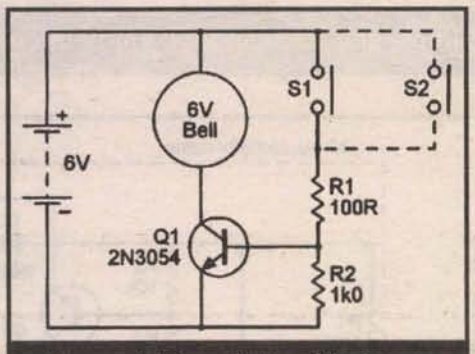

Figure 4. Transistor-aided non-latching close-to-operate alarm.

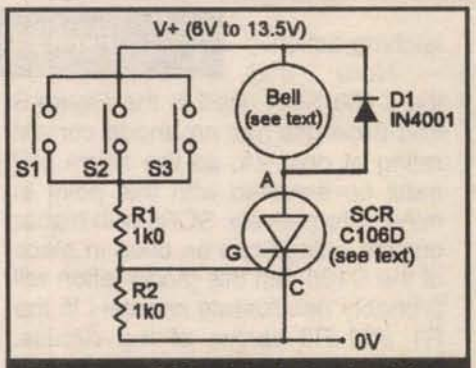

Figure 5. SCR-aided non-latching close-to-operate alarm.

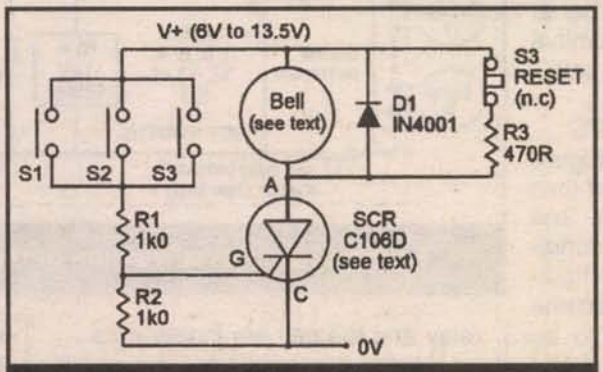

Figure 6. SCR-aided self-latching close-to-operate alarm.

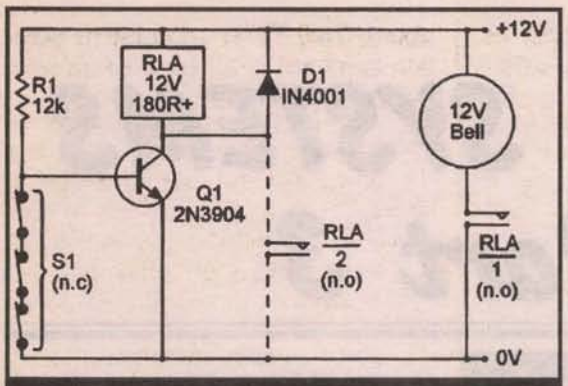

Figure 7. Simple open-to-operate alarm draws a 1mA standby current.

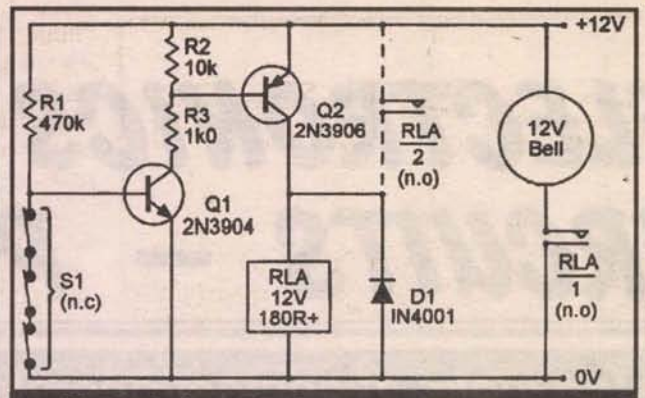

Figure 8. Improved open-to-operate alarm draws a 25µA standby current.

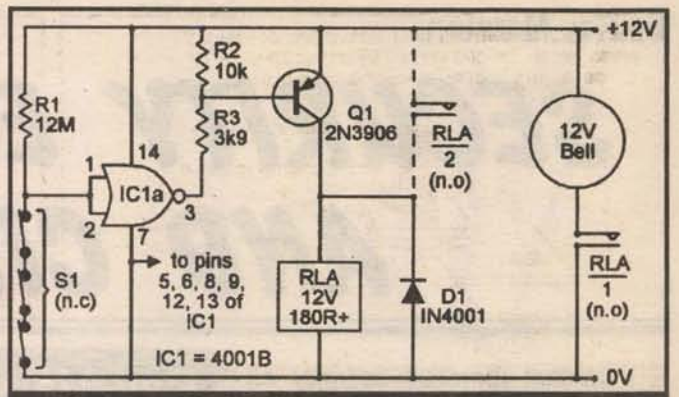

Figure 9. CMOS-aided open-to-operate alarm draws a 1µA standby current.

problem is to use an SCR (silicon controlled rectifier) as the slave device, as shown in Figures 5 and 6. These circuits rely on the fact that ordinary electromagnetic alarm bells are self-interrupting solenoid devices that incorporate a self-activating on/off switch in series with the solenoid's supply line.

This switch is normally closed, allowing current to reach the solenoid and throw out a striker that hits the bell dome and simultaneously opens the switch, thus breaking the current feed and causing the striker to fall back again until the switch closes again, at which point the whole process starts to repeat, and so on; the bell's operating current is thus drawn in pulsed form.

In the Figure 5 circuit, the alarm bell is wired in series with an SCR that has its gate current derived from the positive supply line via current-limiting resistor R1 and via the parallel-connected n.o. security switches, which (when R1 has a value of 1k0) pass operating currents of only a few milliamps. When all the switches are open, the SCR and alarm bell are off, but when any one of the switches is closed it feeds gate current to the SCR via R1, so the SCR turns on and activates the bell.

Note in this design that, since the bell is a self-interrupting device, the circuit effectively gives a non-latching type of operation in which the SCR and bell only operate while one or more of the switches are closed.

Figure 6 shows how the above circuit can be modified to give self-latching operation. SCRs are inherently self-latching devices that, once they have been initially turned on, remain on until their anode current falls below a 'minimum holding' value, at which point the SCR unlatches and turns off.

In the Figure 5 circuit, the SCR thus automatically unlatches each time the alarm bell self-interrupts, but in the modified Figure 6 design, the bell is shunted via R3, which is wired in series with n.c. switch S4, which ensures that the SCR's anode current does not fall below the C106's minimum holding current value when the bell self-interrupts, thus providing the circuit with a self-latching action.

Note that the C106 SCR used in the Figure 5 and 6 circuits has an anode current rating of only 2A, so the alarm bell must be selected with this point in mind. Alternatively, SCRs with higher current ratings can be used in place of the C106, but this modification will probably necessitate changes in the R1 and R3 values of the circuits. Also note in these SCR circuits that — to compensate for the SCR's typical 1V anode-to-cathode volt drop — the supply voltage must be at least 1V greater than the nominal operating voltage of the alarm bell.

OPEN-TO-OPERATE CIRCUITS

A major weakness of the Figure 1 to 6 circuits is that they do not give a 'fail-safe' form of operation, and give no indication of a faulty condition if a break occurs in the contact-switch wiring. This snag is overcome in circuits that are designed to be activated via normally-closed (n.c.) switches, and a basic circuit of this type is shown in Figure 7.

In Figure 7, the coil of a 12V relay is wired in series with the collector of transistor Q1, and bias resistor R1 is wired between the positive supply line and Q1 base. The alarm bell is wired across the supply lines via n.o. relay contacts RLA/1, and n.c. operating switch S1 (which may consist of any desired number of n.c. switches wired in series) is wired between the base and emitter of the transistor.

Thus, when S1 is closed, it shorts the base and emitter of Q1 together, so Q1 is cut off and the relay and the bell are inoperative.

Under this condition, the circuit draws a quiescent current of 1mA via R1. When S1 opens or a break occurs in its wiring, Q1's base-to-emitter short is removed and the transistor is driven to saturation via R1, thus turning the relay on and activating the alarm bell via relay contacts RLA/1.

This basic circuit gives a non-latching type of alarm operation, but can be made to give self-latching operation by wiring a spare set of n.o. relay contacts (RLA/2) between the collector and emitter of Q1, as shown dotted in the diagram.

Thus, the Figure 7 circuit gives fail-safe operation, but draws a quiescent or standby current of 1mA. This standby current can be reduced to a mere 25µA by modifying the circuit in the way shown in Figure 8.

Here, the value of R1 is increased to 470K, and Q1 is used to activate the relay via pnp transistor Q2, and the circuit's action is such that Q1-Q2 and the relay and bell are all off when S1 is closed, but turn on when S1 is open.

The basic circuit gives a non-latching form of operation, but can be made self-latching by wiring a spare set of n.o. relay contacts (RLA/2) between the collector

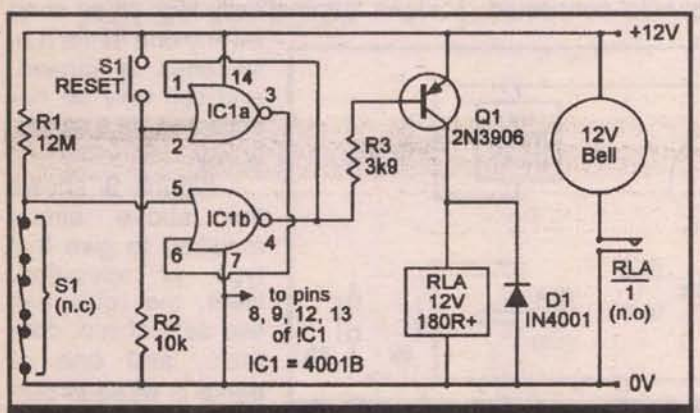

Figure 10. Self-latching CMOS-aided alarm draws a 1µA standby current.

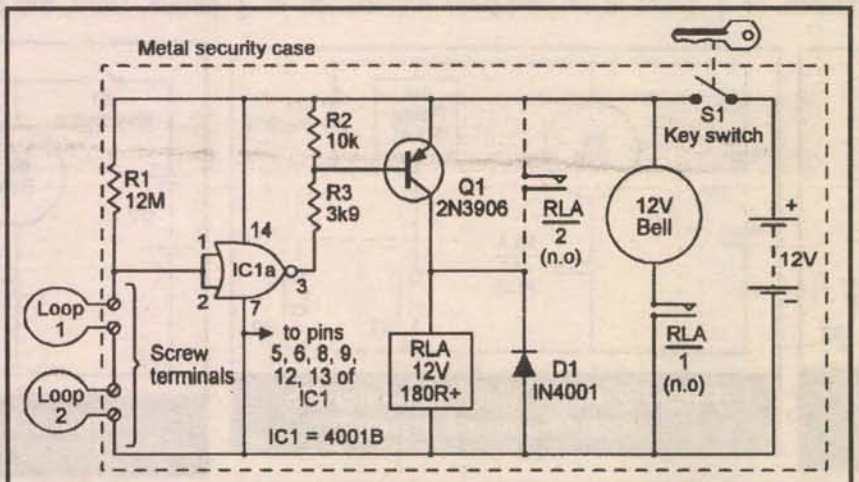

Figure 11. Simple self-latching loop alarm circuit.

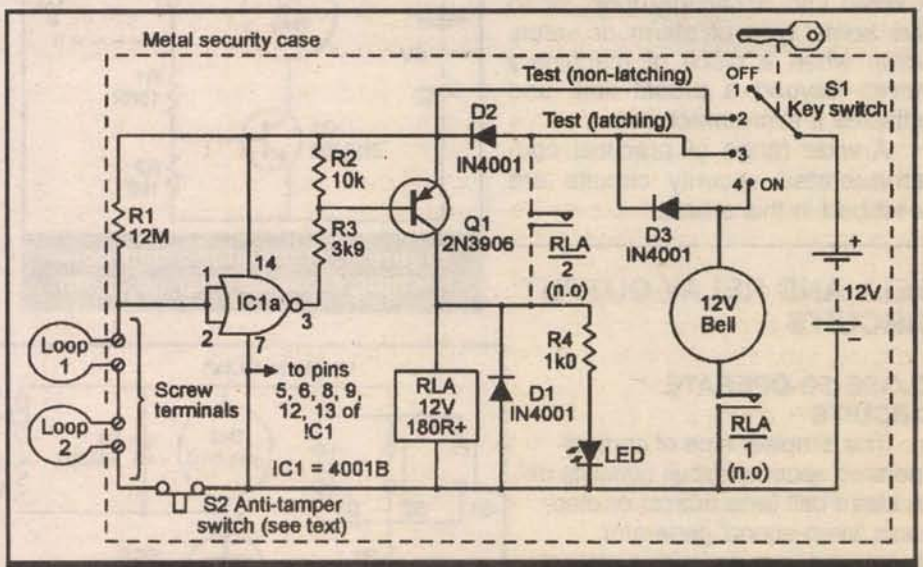

Figure 12. Improved version of the self-latching loop alarm.

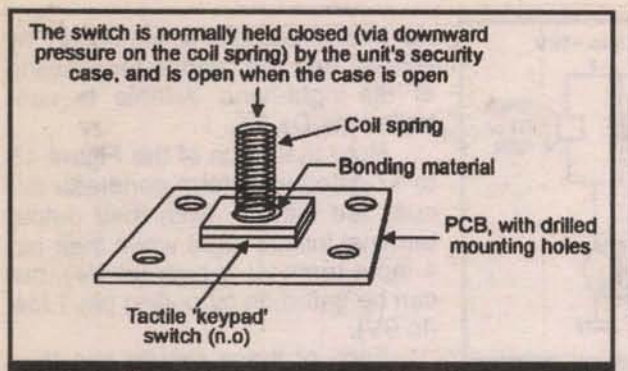

Figure 13. Basic way of constructing an anti-tamper switch (see text).

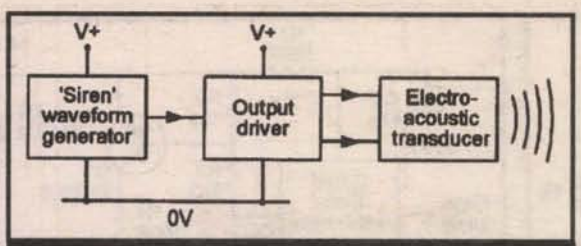

Figure 14. Basic elements of a siren-sound generator.

and emitter of Q2, as shown dotted in the diagram.

If desired, the standby current of the Figure 8 circuit can be reduced to a mere 1µA or so by using an inverter-connected CMOS gate in place of Q1, as shown in Figure 9. The gate used here is taken from a 4001B quad two-input NOR gate IC, and the three unused gates are disabled by shorting their inputs to the 0V line, as shown in the diagram.

The used gate has a near-infinite input impedance, and the standby current of the circuit is determined mainly by the R1 value and by the leakage current of Q1. The basic circuit gives a non-latching form of operation, but can be made self-latching by wiring a spare set of n.o. relay contacts (RLA/2) between the collector and emitter of Q1, as shown dotted in the diagram.

Figure 10 shows an alternative way of making the basic Figure 8 circuit give self-latching operation, without resorting to the use of a spare set of n.o. relay contacts. In this case, the relay-driving transistor (Q1) is driven by a pair of 4001B CMOS NOR gates that are configured as a bistable multivibrator and has an output that goes low and self-latches if S1 is briefly opened or its leads are broken.

As the bistable output goes low, it turns Q1 on, thus activating the relay and alarm bell. Once the bistable has latched the bell into the 'on' state, it can be reset into the standby or 'off' mode by closing S1 and momentarily operating RESET switch S2, at which point the bistable's output latches back into the high state and turns off Q1 and the relay and bell. The circuit draws a quiescent current of about 1µA.

'LOOP' ALARM CIRCUITS

One type of contact-operated alarm circuit that is widely used in large shops and stores (and also in domestic garages and garden sheds) is the so-called 'loop' alarm, in which a long length of wire is run out from the alarm unit, is looped through a whole string of 'to be protected' items in such a way that none of them can be removed without cutting or removing the wire, and is then looped back to the alarm unit again, to complete a closed electrical circuit.

The alarm sounds instantly if an attempt is made to steal any of the protected items by cutting the wire loop, i.e., by effectively opening its 'contacts.' Figure 11 shows the circuit of a simple battery-powered unit of this type.

The simple Figure 11 loop alarm circuit is a modified version of the self-latching CMOS-aided Figure 9 circuit, with its series-connected S1 security switches replaced by a number of series-connected wire 'loops' that — when key-operated switch S1 is closed — activate the self-latching alarm if any part of the loop wiring becomes open circuit.

In the diagram, only two loops are shown, but in practice any desired number of loops can be used. The entire circuit (except the loops) is housed inside a metal security case, and the loops are connected to screw terminals on the main circuit board via grommet holes in the side of the case; unwanted loops can be replaced by short circuits connected between the appropriate screw terminals. The entire circuit can be turned on and off via key switch S1.

Figure 12 shows an improved version of the Figure 11 self-latching loop alarm circuit. The first points to note about this version of the circuit are that a LED is connected across the relay coil via R4 and thus illuminates and gives a visual indication whenever the relay is turned on, and that the circuit's +12V power feed is controlled via four-way key switch S1 and diodes D2 and D3. When S1 is in position '1,' the entire circuit is turned off. When S1 is in position '2,' the main part of the circuit (including the LED indicator) is active, but the alarm bell and self-latching facility are disabled. This TEST (non-latch) position is meant to be used when testing the loop wiring.

When S1 is in the position '3' TEST (latching) position, all of the circuit except the bell is enabled. When S1 is in the position '4' ON position, the entire circuit (including the alarm bell) is enabled, and the circuit gives normal 'security' operation.

The final point to note about the Figure 12 circuit is that n.c anti-tamper switch S2 is wired in series with the loop network and (when S1 is set to the ON position) activates the self-latching alarm if it (S2) takes up an 'open' state.

S2 is actually an ordinary n.o. tactile 'keypad' switch with a short coil-spring bonded vertically to its touch-pad, and is fixed to the main circuit board in such a way that the switch is held in the closed n.c. position (via the spring) when the circuit's security case is closed, but opens (thus sounding the alarm) if the case is opened while the alarm system is still turned on.

Anti-tamper switches of this basic type are quite easy to make from readily-available components. Figure 13 illustrates the basic method of construction.

Before leaving this BELL AND RELAY-OUTPUT CIRCUITS section of this article, note that the various relay-output circuits shown in Figures 2, 3, and 7 to 11 can, if desired, be used to activate any type of electrical or electronic alarm or system via their n.o. relay contacts when the relay is triggered in response to an input contact-switching action, and are thus not restricted to use with alarm

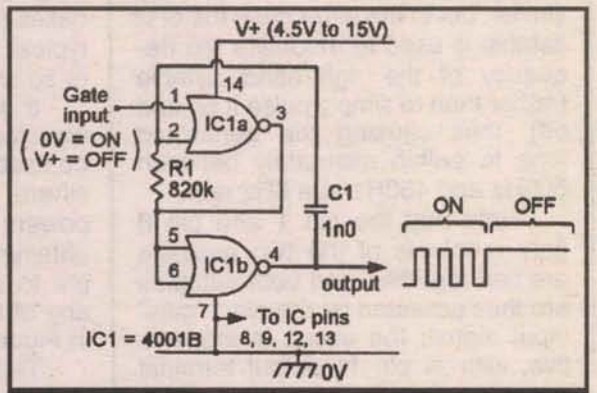

Figure 15. Basic 800Hz monotone 'siren' waveform generator circuit.

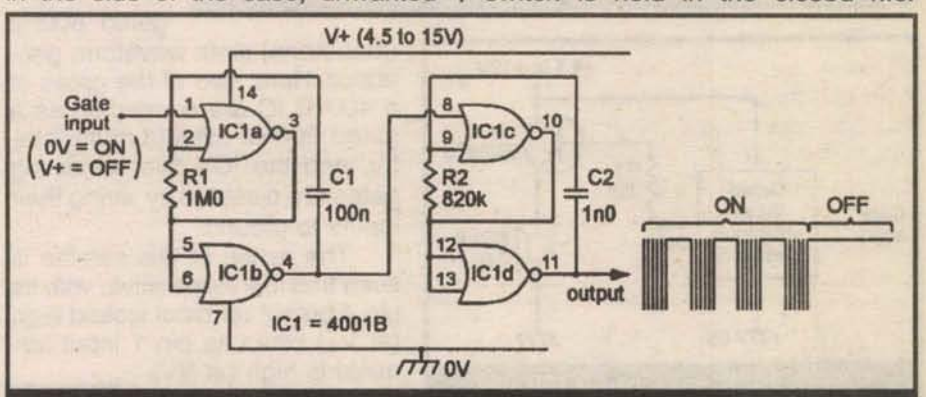

Figure 16. Basic pulsed-tone 'siren' waveform generator circuit.

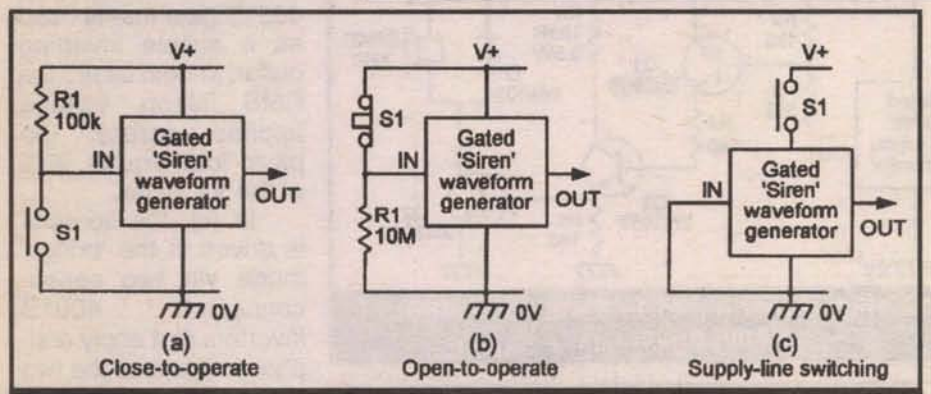

Figure 18. Alternative ways of gating the Figure 15 to 17 'siren' waveform generator circuits.

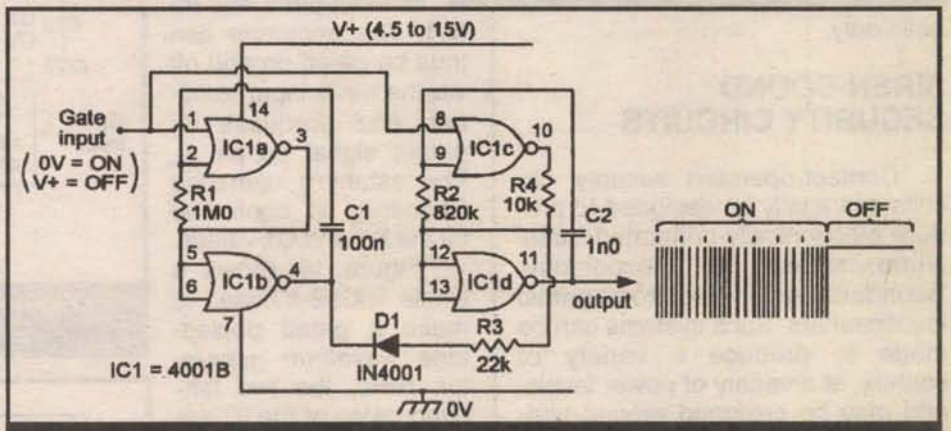

Figure 17. Basic warble-tone 'siren' waveform generator circuit.

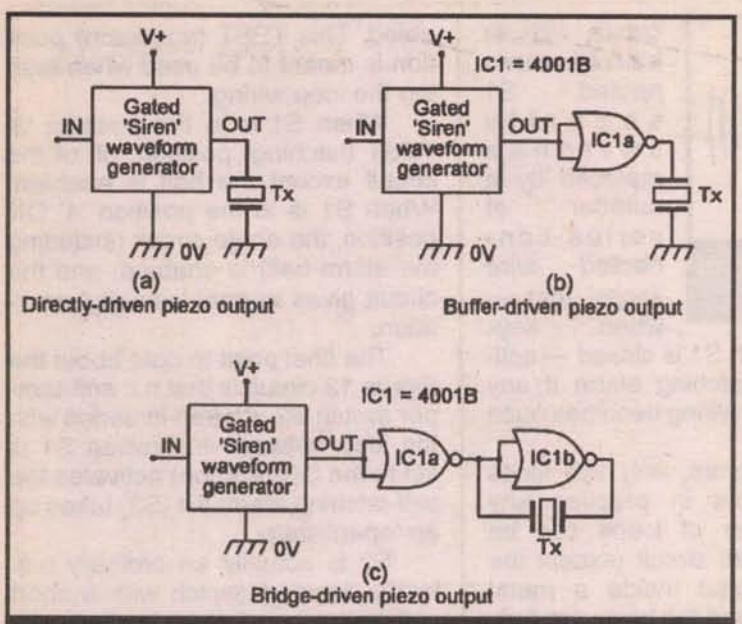

Figure 19. Alternative ways of driving a piezoelectric 'sounder' from the outputs of the Figure 15 to 17 'siren' waveform generator circuits.

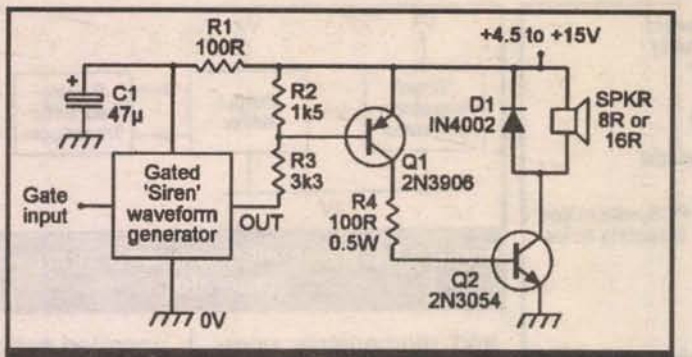

Figure 21. Medium power (up to 6.6 watts into 8R0) output driver.

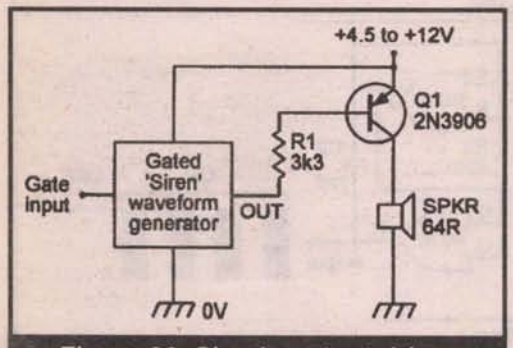

Figure 20. Simple output driver circuit that can feed up to 520mW into a 64R speaker load.

bells only.

SIREN-SOUND SECURITY CIRCUITS

Contact-operated security circuits can easily be designed to produce electronically-generated 'siren' alarm sounds in piezoelectric 'sounders' or in electromagnetic loudspeakers. Such systems can be made to produce a variety of sounds, at a variety of power levels, and may be designed around various types of semiconductor devices.

All siren-sound generators take the basic form shown in Figure 14, and consist of a siren waveform generator, an output driver, and an electro-acoustic transducer.

One of the cheapest and most useful semiconductor devices for use in this type of application is the CMOS 4001B quad two-input NOR gate IC, which draws near-zero standby current, has an ultra-high input impedance, can operate over a wide range of supply-rail voltages, and can be used in a variety of waveform-generating applications.

The rest of this article shows various ways of using one or two 4001B ICs and a few other components to make a variety of contact-operated siren-sound security circuits.

Figures 15 to 17 show three different ways of using 4001B ICs to make practical siren waveform generator circuits.

Figure 15 shows the basic circuit of a simple gated 800Hz (monotone) siren waveform generator. Here, two of the gates of a 4001B IC are connected as a gated 800Hz astable multivibrator, and the IC's two remaining gates are disabled by wiring their inputs to ground.

The action of this astable is such that it is inoperative, with its pin 4 output terminal locked high (at V+) when its pin 1 input terminal is high (at V+), but acts as a squarewave generator when its input pin is low (at 0V). The generator can thus be gated on and off via the pin 1 input terminal, and produces its output signal on pin 4. The astable's operating frequency is controlled by the R1 and C1 values.

Figure 16 shows a single 4001B IC used to make a gated pulsed-tone waveform generator. Here, the two left-hand gates of the IC are wired as a gated low-frequency (about 6Hz) astable squarewave generator, and the two right-hand gates are wired as a gated 800Hz astable that is gated via the 6Hz astable.

The action of this circuit is such that it is inoperative, with its pin 11 output terminal locked high (at the positive supply rail voltage) when its pin 1 input terminal is high, but becomes active and produces a pulsed-tone output on pin 11 when its input pin is low (at 0V).

This generator can thus be gated on and off via the pin 1 input terminal and, when gated on, produces a 800Hz tone that is gated on and off at a 6Hz rate. The operating frequency of the 6Hz astable is controlled by R1-C1, and that of the 800Hz astable is controlled by R2-C2.

Figure 17 shows how the Figure 16 circuit can be modified so that it produces a warble-tone alarm signal. These two circuits are basically similar, but in the latter case the 6Hz astable is used to modulate the frequency of the right-hand astable (rather than to simply pulse it on and off), thus causing the generated tone to switch alternately between 600Hz and 450Hz at a 6Hz rate.

Note that the pin 1 and pin 8 gate terminals of the two astables are tied together, and both astables are thus activated by the pin 1 'gate' input signal; the circuit is inoperative, with its pin 11 output terminal locked high (at V+) when the pin 1 input terminal is high, but becomes active and produces a warble-tone output on pin 11 when the input pin is low (at 0V).

The operating frequency of this circuit's 6Hz astable is controlled by R1-C1, the center frequency of the right-hand astable is controlled by R2-C2, and the 'warble-tone' swing of the right-hand astable is controlled via D1-R3.

Note that each of the Figure 15 to 17 gated waveform generator circuits are inactive (with their output terminal locked high) when their pin 1 input terminal is high (at V+), but can be gated on by pulling pin 1 low (to 0V).

Each of these circuits can thus be gated on and off by using any of the three input connections shown in Figure 18. Thus, they can be gated on by closing an n.o. switch by using the input connections shown in (a), or by opening an n.c. switch by using the input connections shown in (b), or can be gated on or off by making or breaking the supply line connection by using the input connections shown in (c). In cases (a) and (b), the circuit draws a typical standby current of only 1µA or so when in the 'off' state.

If the Figure 15 to 17 gated waveform generator circuits are to be used in alarm-sound applications where fairly low acoustic output powers are required, these can be obtained by feeding the circuit's output to a low-cost piezo sounder in any of the three basic ways shown in Figure 19.

Thus, in (a), the sounder is driven directly from the generator's output, and in (b), it is driven via a 4001B gate that is used as a simple inverting buffer; in both cases the RMS 'alarm' voltage applied across the piezo load equals 50% of the V+ value.

In (c), the sounder is driven in the 'bridge' mode via two series-connected 4001B inverters that apply anti-phase signals to the two sides of the piezo load, causing the piezo load to 'see' a squarewave drive voltage with a peak-to-peak value equal to double the V+ value, and an RMS 'alarm' signal voltage that equals the V+ value. The (c) circuit thus gives four times more acoustic output power than either of the (a) or (b) circuits.

If the Figure 15 to 17 gated waveform generator circuits (which each have an output that is locked high when the generator is gated off) are to be used in alarm-sound applications where fairly high acoustic output powers are required, these can be obtained by feeding the astable's output to inexpensive 'low-fi' or horn-type loudspeakers (these have

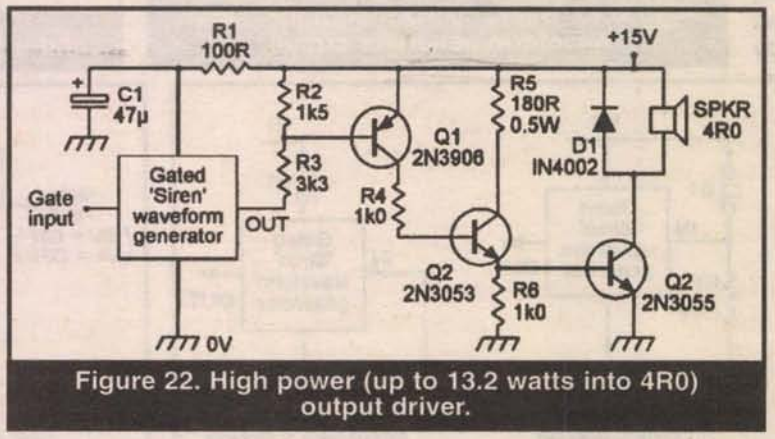

Figure 22. High power (up to 13.2 watts into 4R0) output driver.

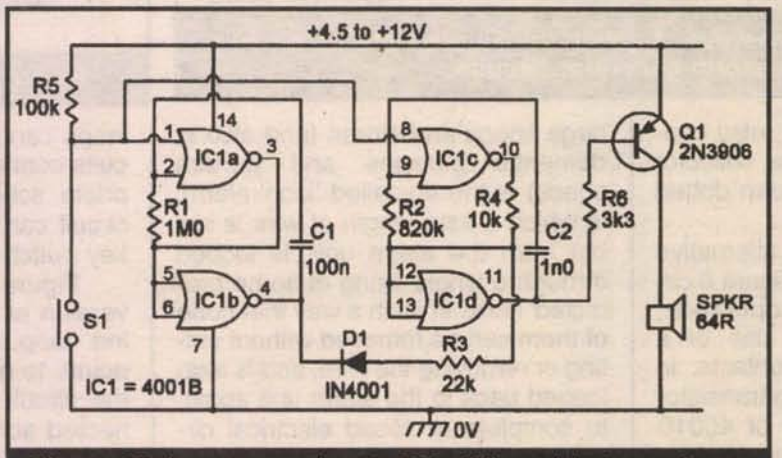

Figure 23. Low-power (up to 520mW) warble-tone alarm-call generator, activated by closing a n.o. switch.

an electro-acoustic power conversion efficiency that is typically some 20 to 40 times greater than a normal hi-fi speaker) via one or other of the simple direct-coupled 'driver' circuits shown in Figures 20 to 22.

Thus, the simple Figure 20 driver circuit is designed to pump a maximum of only a few hundred milliwatts of audio power into a cheap 64R speaker. When the siren waveform generator is gated off, its output is high and Q1 is thus cut off, but when the generator is gated on, its output drives Q1 on and off and causes it to feed power to the 64R speaker. The output power depends on the supply rail voltage, and has a value of about 520mW at 12V, or 120mW at 6V, when feeding a 64R speaker load.

Note that, since Q1 is used as a simple power switch in this application, very little power is lost across the 2N3906 transistor, but its current rating (200mA maximum) may be exceeded if the circuit is used with a supply value greater than 12V.

The Figure 21 driver circuit can pump a maximum of 6.6 watts of audio power into an 8R0 speaker load, or 3.3 watts into a 16R load. Here, both transistors are cut off when the waveform generator is gated off, but are switched on and off in sympathy with the siren waveform when the generator is gated on.

Note in this circuit that the positive power supply rail is fed directly to the output driver, but is fed to the waveform generator via decoupling network R1-C1, that voltage divider R2-R3 ensures that the output stages are not driven on until the generator's output voltage falls at least 1.9V below the supply rail value, and that diode D1 is used to damp the speaker's back-EMF when driver Q2 switches off.

Finally, the Figure 22 driver circuit can pump a maximum of 13.2 watts into a 4R0 speaker load when powered from a 15V supply. Here, all three transistors are cut off when the waveform generator is cut off, but are switched on and off in sympathy with the siren waveform when the generator is gated on.

Thus, Figures 15 to 17 show three alternative 'siren' waveform generator circuits that can — when used in practical contact operated security circuits — each be gated in any of three basic ways and be used in conjunction with any of six basic types of acoustic output driver circuit, thus offering a total of 54 different circuit combinations.

Figure 23, for example, shows how the Figure 17, 18(a) and 20 circuits can be combined to make a warble-tone alarm-call generator that can be activated by closing an n.o. switch and which can pump 520mW into a 64R speaker load when operated from a 12V supply. **NV**

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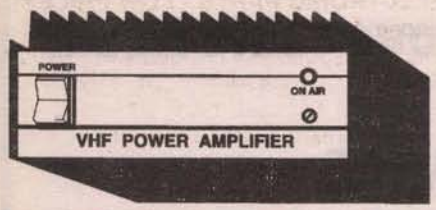

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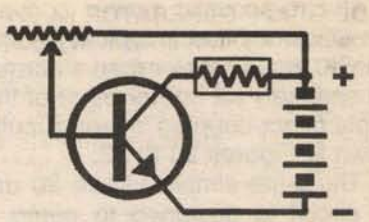

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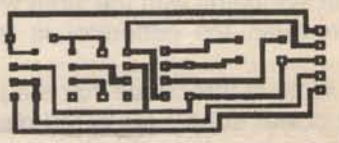

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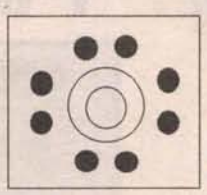

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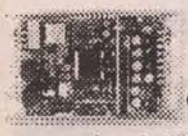

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PS-303 $159.00, 30V/3A.
PS-305 $219.95, 30V/5A.
PS-1610S $289.00, 16V/10A.
PS-2243 $139.00, 12V/24V select, 3A.
PS-2245 $159.00, 12V/24V select, 5A.
8107 $399.95, 30V/10A.
8110 $289.95, 60V/3A.
8112 $399.95, 60V/5A.

Digital Voltmeter & Analog Ammeter
8200(8201) $179.95($239.95), 30V/3A(5A)
Digital Displays **8210/8300 $199.95,** 30V/3A.
8211/8301 $259.95, 30V/5A.

DUAL OUTPUTS
Independent/Tracking
Analog Displays
8108 $549.95, 60V/3A.
8109 $699.95, 60V/5A.

PS-303D $314.95, 30V/3A. **PS-305D $399.95,** 30V/5A.

TRIPLE OUTPUTS, **a fixed 5V/3A output, Independ/Tracking**
Digital Displays **8202(8203) $499.95($549.95),** dual 30V/3A(5A).
Analog Displays **8102(8103) $399.95($489.95),** dual 30V/3A(5A), with *Parallel* (30V/6A) and *Series* (60V/3A) Mode operation.

NTSC/PAL TV COLOR BAR GEN.

CPG-1366A $159.95, VHF NTSC;
Freq.: 45.75, 175.25, 187.25 MHz;
RF Output: 10mV.
Impedance: 75 Ohm;
Video Output: BNC, $1V_{p-p}$.

CPG-1367A $159.95, VHF PAL.

SWR/RF/mW POWER METER

310 $89.95, 1.8-150MHz; *RF Power:* 0-4W/20W/200W 3 ranges; *SWR Measurement.:* 1.0~∞, 4W minimum. Accuracy: 5%-10%; *Insert Loss:* .3dB *Input/Output Imp.:* 50Ω; SO-239 plug
320 $89.95, 130-520MHz. Spec. 310.
330 $119.95, 1.8-520MHz. Spec. see 310.

SWR-3P $26.95 1.7-150MHz,
RF Power: 0.5-10W, 0.5W-100W.
SWR-2P $22.95, 1.7-30MHz; *RF Power:* 0.5-10W.

mW RF Power Meter 340 $219.00, 1.8-500MHz; *RF Power:* 20mW/200mW/2W 3 ranges; *Imped.:* 50Ω; *Accuracy:* ±10% full scale; SWR <1.15; N-type connector; BNC type output..

FM STEREO MODULATOR

AG-2011A $549.00
RF SECTION:
Carrier: 98MHz ±2MHz,
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion < .5%; *L-R Separation:* >50dB.
EXT. MODULATION: *Freq.:* 50Hz-15KHz
L-R Separation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz.

TOOLKITS - ELECTRONIC/PC

97A5 $29.99 U.S. Patented, 45-pcs. Contents: IC inserter/extractor with securers & bows, 3-prong part retriever, #0 phillips screwdriv-er, 1/8" flat srewdriver, self-hold tweezers, metal tweezers, extra parts tube, soldering iron, solder, crimping tool, long-nose plier, cutting plier, zipper vinyl case. Bits include: *Phillips:* #0/#1/#2/#3; *Flat:* 1/8"/3/16"/1/4"/9/32"; PZ1/PZ2; T8/T9/T10/T15/T20/T25/T27/T30/T40/T45; *Hex:* 5/64"/3/32"/1/8"/5/32"/3/16"; *Sockets:* 3/16" (5mm)/7/32" (5.5mm)/1/4" (6mm)/9/32" (7mm)/5/16" (8mm).
8G23 $34.99 23-pcs *Contents:* IC inserter/extractor with securer & bows, 3-prong part retriever, 3/16"/1/4" nutdriver, 3/16"/ 1/8" slot-ed screwdriver, #0/#1 phillips, reversible T10/T15 bits, re-versible #2 phillips/¼" slotted bits, tweezer, long-nose plier, cutter, 6" adj. w-rench, soldering iron, solder, crimping tool, zipper case, manual.
Different packages available, call/write/e-mail/fax for detail.

STEREO/ALIGNMENT/SWEEMAR SCOPE

STEREO SCOPE **OS-7505B $369.00,** 0-10MHz/20mV.
ALIGNMENT SCOPE OS-7001A $369.00, 0-200KHz/1mV.

SWEEMAR SM-6225B/C $1999.95
Freq Range: (AM)490KHz; (FM)10-11.4MHz; *Accuracy:* ± 0.1%; *Marker:* (AM)455KHz, ±5KHz, ±10KHz; (FM)10.7MHz, ±7.5KHz, ±150KHz.

RF SIGNAL GENERATOR

SG-4160B $124.95, 100KHz-150MHz up to 450MHz on 3rd harmonics in 6 ranges; AM modulation; *Accucy:* ±5%. *RF Output:* 100mVrms to 35 MHz; *Modulation:* Int. 1KHz (AM) =30%; Ext. 50Hz-20KHz, at least $1V_{rms}$ input. *Audio Output:* 1KHz, $2V_{rms}$ minimum.
SG-4162AD (with Freq. Counter) $229.95, Spec. see SG-4160B.
COUNTER SECTION: 10Hz-150MHz; *Max. Input:* ≤3V effective *Gate Time:* .1, 1sec. *Input Sensitivity: 35mV, 10Hz-200MHz. Input Impedance:* 1MΩ(HF), 50Ω(VHF). *Display:* 7-digit LEDs.

AM/FM STD SIGNAL GEN.

SG-4110A $1799.00, *Freq:* 0.1~110MHz; *Display:* 6-digit LED; Resolution: 100Hz (0.1~34.999MHz); 1KHz (35MHz~110MHz). *Accuracy:* <±($5x10^5$ ±1 count); *Output:* -19dBu—99dBu, 1dB steps. *Impedance:* 50Ω VSWR 1.2; 100 preset frequency & store functions

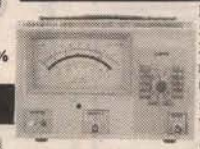
AUDIO GENERATOR

AG-2601A $124.95, 10Hz~1MHz in 5 ranges; *Output:* sinewave 0~$8V_{rms}$; square $10V_{p-p}$. *Output Imped:* 600 Ohm. *Distortion:* <0.05% 500Hz~50KHz, <0.5% 50KHz~500KHz.
AG-2603AD $229.95, with 6-digit, Int/Ext. Freq Counter, 10Hz~150MHz, *Output Control:* 0/-20/-40dB & Fine adjuster. Spec. see AG-2601A.

FUNCTION GENERATOR

FG-2100A $169.95, 0.2Hz-2MHz in 7 ranges; sne, square, triangle, pulse & Ramp; *Output:* $5mV_{p-p}$-$20V_{p-p}$, 1% distortion. *VCF:* 0-10V/freq. to 1000:1.
FG-2102AD $229.95 see FG-2100A; 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy.
FG-2020B $159.00 0.5Hz-500KHz; Sine, Square, Triangle.
FG-2103 $329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges. *Operating Mode:* sweep, AM, gated burst, VCG. *Freq. Counter:* Int. 0.5Hz-5MHz; Ext. 5HZ-10MHz.
FG-513 $769.95, 13 MHz, Microprocessor embedded dgital sweep; Sine, Square, Triangle, Pulse, Ramp, TTL & DC; ±(.01%+1dgt). *Freq. Counter & TCXO:* 5Hz-100MHz, 6.5 digits. x1/x20 attenuatn

AC MILLIVOLT METER



MV-3100A $159.95 wide band 5Hz~1MHz; 3 scales, mV, dB &dBm; 300μV~100V in 12 ranges, 10μV resolution; -70~40dB in 12 ranges, 0dB=1Vrms,0dBm=0.755V); ±3% accuracy; Input impedance 10MΩ; Noise <2%. **MV-3201B $309.95** dual channels, simultaneous measurement..

OSCILLOSCOPES

OS-7305B $249.00 DC~7MHz; 3" CRT; *Horz:* .25V/div; 10Hz~100KHz in 4 ranges; *Vert:* 10mV/div; Int. & Ext. Sync.; *Input:* 1MΩ/35pF.
OS-7010A $299.95 10MHz, 5"CRT, *Horz:* .2V/div; *Vert:*10mV~10V /div.
OS-622G $389.95 20MHz, 2 CH/X-Y Alt trigger, trigger lock, hold OFF, TV syn., 8x10 div., 1mV/div., *Horz:* .2μs~.5s/div; *Vert:* 1mV~5V/div.
OS-653G $699.95 50MHz, 2 CH/delay sweep, Alt trigger, TV syn.
OS-6101G $1499.95 100MHz, 4ch/8 traces, delay sweep, cursor readout. *2 years warranty for OS-622G, OS-653G, & OS-6101G.*

UHF ATTENUATORS

RT-8815U (50Ω) $299.00 / RT-8817U (75Ω) $299.00, 950MHz, 81dB, 0.5W max.; *Steps:* 1/2/3/5/10/20/20/20, 8 switches.
085E-2 (50Ω) $399.00 / 087E-2 (75Ω) $399.00, 950MHz, 81dB, 0.5W max.; *Steps:* 10dB+7.1dBx10, Electronic adjustment knob.

MICROPROCESSOR TRAINER

BGC-8088 $699.00, learn computer theory. Excellent for school & individual who want to learn about ROM, RAM, I/O ports, programming, & run a 8088 Microprocessor. An easy to understand step-by-step manual guides you to achieve your goal. 56-key keyboard, LCD display, RS-232, UART...

GRID DIP METER

DM-4061 $89.95 1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode. *Modulation:* ≈ 2KHz Sinewave. *Crystal Oscillator:* 1-15MHz. Wave absorption meter. 9VDC battery.

FREQUENCY COUNTER

FC-5250C $119.95 10Hz-220MHz (HF)10Hz-20MHz, (VHF)10-200MHz. *GateTime:* .1, 1sec. *Max. Input:* $10V_{p-p}$. *Input Sensitivity:* 35mV/10Hz-200MHz *Input Imped.:* 1MΩ(HF), 50Ω(VHF). *Display:* 7-digit LEDs; 9V adapter **($6)**
FC-5260A $129.95
10Hz-600MHz. 7-digit LEDs.
FC-5270 $149.95
10Hz-1.2GHz; 8-digit LEDs.
FC-5600B $229.95
10Hz-600MHz; 10-digit LEDs.
FC-5700 $299.95 10Hz~1.3GHz; 10-digit LEDs. Period measure.

SIGNAL TRACER/INJECTOR

($ Reduction!) SE-6100 ~~$134.95~~ $89.95
TRACER: Gain 60dB maximum. *Attenuation:* 0/20/40/60dB *Input Imped:* 100KΩ; *Meter:* Vu 100μA *Output Imped.:* 600Ω; *Speaker:* 8 Ω.
INJECTOR: ≈1KHz Squarewave; *Output Level:* Variable 0 ~ $4.5V_{p-p}$; 9V battery or adaptor **($6.00)**.

LCR METERS

MIC-4070D $179.95, *Induct.:* 0.1μ~200H, *Capacit.:* 0.1p~20mF, *Resist.:* 1mΩ~20MΩ, 2Ω range, Dissipation factor measurement, Zero adjust; Surface mount device (SMD) test probe: **LT-06 $21.95**

DIGITAL MULTIMETER

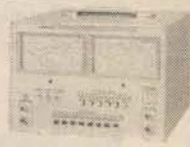
DMM-120 $24.95, 3½ digit, 600VDC, 2ADC 500VAC, 2MΩ, hFE/diode/continuity test; 1.2%.
DMM-123+Capacitance $44.95, 3½ digit, 600VDC/600VAC, 10ADC/AC, 2GΩ, 20μF, hFE/diode test, continuity beeper; 0.8% accuracy.
DMM-124+Cap.+Temp.+Freq $69.95, 3½ dig, 600VDC/500VAC, -58~752° F, 2GΩ, 20mF, 200KHz, 3φ phase/diode/continuity test; 1.2%.
DMM-125 $54.95, Autorange/Bargraph, 32MΩ, 600VDC/AC, 10ADC/AC, diode/continuity test.
MIC-35 $59.95, Autorange, 3¼ LCD, 20MΩ, 1000VDC/750VAC, 20ADC/AC, data hold, diode/continuity test, free holster, 0.5% accuracy.
MIC-39 $129.95, Autorange/Bargraph, True RMS, 3¼ LCD, 40MΩ, 40μF, 1000VDC/750VAC, 20ADC/AC, 600KHz freq. cntr, data hold, sleep mode, memory, read functions, holster; 0.3% accuracy.

AUTO. CAPACITANCE METER

CM3300A $139.00 10 ranges, 99.9pF ~ 99.9mF, fully automatic. *Resolution:* 0.1pF lowest, 0.1% full scale. *Accuracy:* 0.5% of full scale ±1 digit to 99.9μF, 1% of full scale ±1 digit to 99.9μF. *Display:* 3 digit LED. *Unit:* pF, nF, μF, mF, Overrange indicators.

AUTO DISTORTION METER

DM-3104A $799.95
DISTORTION MEASURE
Range: 0.01% to 30%, 0.1/0.3/1/3/10/30% 6 ranges. *Freq:* 400Hz±10%, 1KHz±10%(HPF). *Input:* 3mV-100V; Ratio measure 20dB. *Auto. Freq. Switching Ranges:* Fundamental Freq. = (fo)±10%; *Fund. Rejection:* >-80dB at (fo)±5%; >-70dB at (fo)±10%. *Harmonic Accuracy:* ±0.5dB, 1.8(fo)-20KHz.
LEVEL MEASURE *Range:* 0 to 100V in .03/.1/.3/1/3/10/30/100V *Freq Response:* ±0.5dB/20~50kHz; ±1dB/20~100kHz.
DM-3204 $1,599.00 dual channels; Spec see DM-3104A.



WOW-FLUTTER METER

WF-3103A $699.95 *Freq. Range:* 3KHz±10% JIS/CCIR; 3.15KHz±10% DIN. *Measuremt:* .03/.1/.3/1/3% full scale. *Accuracy:* ±5% of full scall.
WF-3105A $799.95, digital display; *Function:* LIN/WOW/Flutter/WTD. *Freq Counter:* 10Hz-9.99MHz. *Indication:* CCIR/DIN/JIS.

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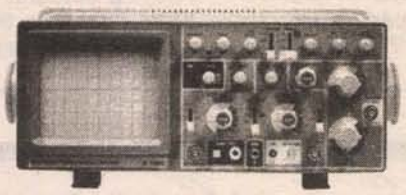

S-1325	25MHz		$325
S-1330	25MHz	Delayed Sweep	$439
S-1340	40MHz		$475
S-1345	40MHz	Delayed Sweep	$569
S-1360	60MHz	Delayed Sweep	$749
S-1390	100MHz	Delayed Sweep	$895
DS-303	40MHz/20Ms/s	Analog/Digital	$895
DS-603	60MHz/20Ms/s	Analog/Digital	$995

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NEW

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- Capacitance .1pF to 20µF
- Inductance 1µH to 20H
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- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

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- Automatically identifies width, depth and speed of SIMMs.
- 10 built-in tests identify mosts memory defects Pre-heat cycle prior to tests.

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- Audio Tone
- Compact Size
- Self Power Check

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2716	$0.65	27C512	$1.95
2732	$0.65	27C010	$2.25
2764	$0.65	27C100	$2.25
27C64	$0.65	27C1001	$2.25
27128	$0.65	27C1024	$2.25
27128A	$0.65	27C020	$2.95
27256	$1.25		

All DRAMS are clean socket pulls and have full leads.

4164-15	$0.18 Ea.	41256-15	$1.00 Ea.
4164-12	$0.25 Ea.	41256-12	$1.25 Ea.
		41256-10	$1.35 Ea.

NEW ALPS 2.88 MEG 3.5" FLOPPY DISK DRIVE FOR 755 SERIES THINKPAD LAPTOP

New 2.88 Meg 3.5" floppy disk drive mfr. by Alps for IBM Thinkpads 755 Series computers. This drive replaces the 1.44 Meg drive by transferring it into the original mounting bracket (5 min.) and it will be auto-detected when the computer is started. Supports 720K/1.44Meg/2.88Meg standards.

TP755/2.88 (IBM P/N 1619718) ..... $49.95 Ea.

NEW HAYES ACCURA 28.8 INTERNAL FAX/MODEM

28.8 Hayes Accura internal plug-n-play fax/modem. Card comes with Quarterdeck InternetSuite 2 and Webtalk. Requires 16 bit ISA slot. Windows 95 Plug-n-Play compatible. Five year manufacturer's warranty. Accura 28.8B Fax Modem ..... $49.95 Ea.

NEW INTEL A80487SX PGA MATH CO-PROCESSOR

New retail box Intel math co-processor comes complete with used guide, utility and diagnostic software. Great price and easy installation on upgradable systems. (Chip package 169 pin PGA.) A80487SX ..... $24.95 Ea.

NEC 6X CD-ROM DRIVE FOR VERSA 2400 SERIES

New fast 6X CD-ROM add-on or upgrade for NEC Versa 2400 laptop computer. Slides easily into VersaBay 2400 slot. One year manufacturer's limited warranty.

OP-260-65001 (Versa CD 6X Drive) ..... $69.95 Ea.

NEW COLORADO JUMBO 120 INTERNAL TAPE BACKUP DRIVE

New Colorado Jumbo 120 tape backup system has up to 120MB capacity using data compression. Installs in minutes connecting to most existing floppy controllers. Includes powerful, easy-to-use Colorado backup for DOS software program. Fits into 5-1/4" or 3-1/2" half height drive bays. QIC-40 compatible. Kit includes: drive, cable, mounting screws, and all documentation. Note: Tape not included.

Jumbo 120 Tape Backup ..... $29.95 Ea.

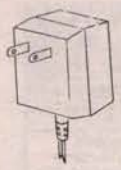
USED MICROSOFT PS/2 MOUSE
(New Style Contoured Type)

Used Microsoft PS/2 mouse, from older upgraded computer systems. All test with 30-day warranty.

Used MS PS/2 Mouse ..... $6.95 Ea.

WALL PLUG WALL ADAPTERS

Input: 117 Vac 50/60 Hz. Outputs Available.



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8Vdc 500Ma	$2.00 Ea.
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9Vdc 300Ma	$2.50 Ea.
9Vdc 450Ma	$3.50 Ea.
9Vac 500Ma	$2.95 Ea.
9.5Vac 750Ma	$3.50 Ea.
12Vdc 100Ma	$1.25 Ea.
12Vdc 200Ma	$1.50 Ea.
12Vdc 500Ma	$2.95 Ea.
12Vdc 600Ma	$3.95 Ea.
12Vdc 800Ma	$6.95 Ea.
12Vac 830Ma	$4.95 Ea.
14Vdc 700Ma	$5.95 Ea.
16Vdc 1.2Amp	$6.95 Ea.

NOW UP-TO-DATE, WINDOWS 3.1 & WINDOWS 95 SCHEDULE AND CONTACT MANAGEMENT SOFTWARE

Powerful schedule, To-Do lists, Contacts, printing Avery labels, Day timer book formats. CD-ROM contains Windows 3.1 & Windows 95 versions. 10MB hard disk space, VGA or SVGA display, mouse required. New retail box.

Now Up-To-Date (CD-ROM) ..... $9.95 Ea.

NEW NISCAN/GS PLUS OCR/ 256 GRAY SCALE SCANNER

Brand New True 256 Gray Scale Hand Scanner.
Resolution: 25-400 DPI.
Scan Width: 4.2 In. Scan Length: 11 In.
Interface: 16 Bit high speed (ISA) card, 64K SRAM. System Requirements: 286/386/486 PC Compatible (16MHz).
Available 16-Bit interface slot, Windows 3.1, 4 Meg RAM, 10 Meg of Available HD space (Min.), Mouse or Other pointing device.
Software Included: Picture Publisher LE 3.1, (Imaging Software), Perceive Personal 2.1, (OCR Software)

Niscan/GS Plus ..... $29.95 Ea.

NEW TANDY SUPER VGA 1 MEG DRAM
(16-Bit ISA Bus Type)

This board is your basic super VGA video board with 1 meg of DRAM type memory. (ISA BUS TYPE.) Core Logic Chip: WD90C31-ZS-00-02. Resolution/Color: 640x480/256C, 800x600/256C, 1024x768/256C, 1024x1024/16C. Note: Software drivers included with board. Windows 3.1, VESA, Autocad, etc.

Tandy SVGA 25-4055 ..... $12.95 Ea.

NEW 300W BABY SWITCHING POWER SUPPLY
UL & CSA RATED 110-220VAC

Input voltage: 110-220VAC 50Hz/60Hz UL & CSA. Output voltage: +12VDC @ 12 amp/-12VDC @ 0.5 amp: +5VDC @ 30 amp/-5VDC @ 0.5 amp.

Model # Hipro HP-300PPFS ..... $39.95 ea.

NEW INTEL N80287XLT MATH CO-PROCESSOR

New retail box Intel math co-processor comes complete with used guide, utility and diagnostic software. Great price on a hard-to-find part for 286 laptops. (Chip package 44 pin PLCC.)

N80287XLT ..... $19.95 Ea.

NEW CYRIX FASMATH COPROCESSOR CX-83D87-33-GP

New Cyrix FasMath coprocessors for 80386DX16-33 systems. This FPU unit is used in place of Intel's 80387DX16-33 part. Originally priced at $100.00, a steal $10.95. Case: 68 pin grid array.

Cyrix CX-83D87-33-GP ..... $10.95 Ea.

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115 Vac 3.1" or 4.7"	$7.95 Ea.
12 Vdc 3.1" or 4.7"	$6.00 Ea.
12 Vdc 2-3/8"	$4.95 Ea.
12 Vdc 2-5/8"	$6.00 Ea.

HARVARD GRAPHICS 4.0 (CD-ROM)

The easy way to create professional presentations. Designed exclusively for Windows 95. Pentium 75 or better. 13MB to 44MB hard disk space, SVGA display, Windows 95, mouse. New retail box

Harvard Graphics 4.0 (CD-ROM) ..... $24.95 Ea.

512K PCMCIA SRAM CARD

New 512K PCMCIA SRAM card made by Fujitsu. Will work in most laptop, PDA, or handheld computers with PCMCIA socket and socket management software. HP100/200, OmniGo, Zaurus, Etc.
Requires one lithium coin battery (BR2325/CR2325).
Note: Battery not included.

Fujitsu (512K SRAM PCMCIA) ..... $24.95 Ea.

NEW 28.8/V.34 PCMCIA MODEM/FAX MADE SIMPLE TECHNOLOGY

New 28.8/V.34 PCMCIA modem/FAX, cellular ready (MNP10-EC & TX-CEL Protocol) with Flash upgradeability to 33.6. Windows 95 Plug n' Play, Hot swap capabilities. Bitware Fax software included.
Note: Separate purchase of connecting cable from Simple Technology needed for cellular operation.

28.8 Communicator (Simple Tech.) ..... $49.95 Ea.

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Pulled from working equipment, tested and guaranteed for 30 days. IDE and SCSI, from 40 Megs to 500 Megs. Call for availability, model numbers, and current pricing.

NEW TEAC 1.2 MEG 5-1/4" FLOPPY DRIVE

5-1/4" Half Height Teac. Model #FD-55GFR.
Tan face plate only.

1.2M TEAC FD-55GRF ..... $14.95 Ea.

NEW 500MEG SCSI 3.5" SEAGATE

ST1480N ..... $74.95 Ea.

NEW 16-BIT 256K ISA VGA CARDS

Designed for the PC-XT/PC-AT & compatibles, this is a basic low cost VGA video card. 256K DRAM with chips & technology 82C451. Full backward compatibility with EGA, CGA, MDA, and Hercules modes. Card type: ISA 16-bit.

Model # VGA 300 (VGA Card) ..... $9.95 Ea.

FIRST AID 95 BY CYBERMEDIA

New retain boxed CD-ROM version for Windows 95 and 3.1. Fixes Windows problems automatically. System Req. IBM Compatible 386 or higher PC with Windows 95, 3.1, 3.11 / 4MEG RAM / 7MEG HD Space.

FirstAID 95 Ver. 2.0 ..... $9.95 Ea.

QUARTERDECK WINprobe4 (3.5" Disk)

Powerful troubleshooting software tool for Windows and Windows 95 operating systems. Program can run over 200 individual tests to keep your system running at full speed. 1MB free HD space required. New retail box.

WINprobe 4.0 (3.5" Disk) ..... $9.95 Ea.

NEW INTERNAL IMES 6X IDE CD-ROM DRIVE

New 6X IDE interface, Caddyless design. Drive comes with instructions sheet, IDE cable, and driver disk for DOS and Windows. Unit is Windows95 Plug & Play compatible.

IMES 6X CD-ROM Drive ..... $49.95 Ea.

NEW MICRONICS PENTIUM HX CHIPSET MOTHERBOARD

New Micronics Model D5CUB Pentium AT style motherboard. This motherboard comes with built-in I/O support for 4) IDE devices, 2 com ports, floppy controller, and printer port. The motherboard is built around the Intel HX Chipset and can support MMX and NON-MMX Pentium CPUs and Cyrix 6X68 CPUs 100MHz through 200MHz, 256K cache, 4) 72-pin SIMM sockets.

Micronics D5CUB ..... $74.95 Ea.

NEW 1.44 MEG 3.5" FLOPPY DRIVE

New 1.44 Meg 3.5" floppy drive with gray face plate.

Floppy 1.44/Gray ..... $19.95 Ea.

NEW INTEL PENTIUM 60/66 CPU HEATSINK 12VDC FAN COMBO

New Pentium 60/66 heatsink 12VDC fan combo for cooling the older, hotter, CPUs. Low profile type with seven inch wires. Can be used on other CPUs if you have the physical space..

Pentium 60/66 CPU Cooler ..... $4.95 Ea.

NEW TEAC COMBO 700 TAPE BACKUP AND FLOPPY DRIVE 1.44 3.5"

The Teac combo is a 3.5" floppy drive and QIC tape backup unit built into 5.25" half height frame. Great for systems with limited drive bays. Tape backup unit utilizes the PC's existing floppy controller. Capacity: 680MB compressed/340MB uncompressed. Tape Format: QIC-3010-MC. Data Trans. Rate: 0.5 & 1Mbps. Tape Media: 3M MC3000XL (400 ft.). Software Incl.: Arcada Backup for Windows 95, Windows 3.1 & DOS (1.44 Meg floppy). (Note: Back-up tape or cables not included with drive.)

FF-3101/700 Combo ..... $69.99 Ea.

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MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.

SATELLITE SAM'S inventory liquidation: 2000 low profile transformers dual output 14 & 42 VAC; saw filters; 24V DC motors w/gear boxes; opto-interruptors OPB-1819; transistors; capacitors; Draco power supplies. Call 1-800-424-1228 or fax 765-289-9403. Sun Distributing of IN.

INVENTORY LIQUIDATION: Transformers dual output 14 vac & 42 vac; saw filters; photodiodes; DC motors w/gear boxes; transistors; capacitors; many other items. Call 1-800-424-1228 or fax 765-289-9403. Sun Distribution of IN.

ALL ITEMS for sale. Pre-assembled cables for Toshiba, advance communication boards, local area network products, telephone products & fiber products, mounting & cable management tool, coaxial communications and I/O products. Ohio Service Supply Company, PO Box 8802, Canton, OH 44711-8802.

SOLAR KING'S MANY MILLION DOLLARS OF SOLAR PANELS IN STOCK. SOLAR PANELS: 6" X 12"15V, @ .125A, 1.5W, $17.95, $150/10, $1,300/100, **6" x 6"** 7.2V @ .065A, .75W, $7.95, $59/10, $500/100, $3,980/1,000. Also credit card solar cells, call wholesale retail mail order, material running low. Cat'l on web: WWW.BNFE.COM BNFE, Rte. 1S, Peabody, MA 01960. T978-536-2000, F978-536-7400. Estab. 1964.

FREE FLYER on cable TV, phones, credit cards info, schematics, project boards, other misc. items. Bill 1-800-879-9657.

CLOSEOUT ITEMS, Tesla coil kit world famous $19, $55/3; wind speed indicator kit $5, $13/3; fan/motor speed control $3, $10/4; voice/sound activated switch modu. $1, 2 speed SW. Motor/lamp control $1/2,12/$5; Mallory Sonalert SC628 $3.50, $16/5, security keylock switch w/2 keys $3/2. Cat'l on web, WWW.BNFE.COM BNFE, Rte. 1S, Peabody, MA 01960. T978-236-2000 F978-536-7400, estab. 1964.

RF FERRITE and iron powder cores. Free catalog. Palomar Engineers, PO Box 462222, Escondido, CA 92046, 760-747-3343. Palomar@compuserve.com

DESOLDER STATIONS: own pump: Hakko pistol style, $250; Ungar 4024 mint, $225; Weller DS1000 readout, $350; Pace solder/desolder: MBT200, $400, MBT210 digital w/TJ70 thermojet NU IR70, $600; Hakko 850 mint w/5NU heads, $900; desolder handpieces: Pace SX25, $75; Ungar 4088AS, $100; airvac 70 watt uses Paces, $50. Air powered: Ungar 2000 desolder, $150; Raychem air pencil, $200; Weller WTCP, $45; EC2000ESD, $100; 600 watt iron, $100. Jim 310-515-2058.

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A NEW text, comprehensive filter design. Contains all transformation, design and charts, including finite Q considerations to design LP, HP, BP, BS filters. Software is also included. $79 + $6 S&H. Contact: Lee Watkins, 3134-93 East McKellips Rd., Mesa, AZ 85213.

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DMM-20 ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle
DMM-22 ($89.95): 4000counts, bar graph, Freq, AC/DC(V,A), Ω, Capacitance, diode, contin.
DMM-23T ($99.95): 4½ digit, high resol. (10uV, 10nA, 10mΩ), hFE, diode, contin., true rms
DMM-895 ($179.00): true rms, AC/DC (V,A), Ω, bar graph, freq, capac., dBm, logic, diode
DMM-113 ($24.95): Pocket Size, DC/ACV, Ω, diode, Continuity beeper
DMM-120 ($24.95): economy type, DCV,ACV, DCA, Ω,hFE, diode
DMM-122 ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity
DMM-123 ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity
DMM-124 ($69.95): Electrical+Temp,DC/ACV, , capacitance, freq, 3 phase, diode, contin.
DMM-125 ($54.95): Autorange + bar graph, DC/AC(V,A), Ω, diode, continuity beeper

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CAP-15 *($49.95)*: 3½ digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution zero adjustment.
LCR-195 *($89.95)*: 1uH-200H (induct.), 0.1pF-200uF(Capac.), 0.01Ω-20M Ω(resistance)
LCR-814 *($189.95)*: 0.1uH-200H, 0.1pF-20mF, 0.1Ω-20MΩ, Q Factor, dissipation, zero adjust
LCR-131D *($229.95)*: autorange, 0.1uH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/1kHz testing mode

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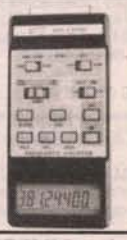
FC-5700 *($329.95)* 1.3GHz bench type, 8 digit, 1 ppm accuracy, 20mV sensitivity, period 0.1us to 100ms. Ideal for test & repair of audio instrument.



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- PS-1000 100MHz Dual Trace $999.95

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- DS-303 30MHz Digital, 20 Samples/sec $849.95
- DS-303P RS-232 interface, 30Mhz $1,049.95

Scope Probe:
HP-9060 (60MHz) $15, HP-9150 (150MHz) $22, HP-9250 (250MHz)$29, HP-9258 (250MHz,100:1)$39

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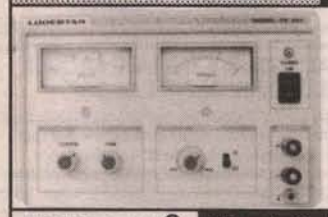
POWER SUPPLIES



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- 1mV/div sen., delay line
- Zaxis input,CH1 output
- Hold off, TV syn.
- 2 probes (x1, x10)

- Dual CH/X-Y operation
- 1 mV/div sensitivity
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- TV syn., trigger level lock
- 2 probes (x1, x10)

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Single Output
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- PR: 2 analog or 2 digital dis

Analog Meters Display
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PS-1850 ($219.95) 18V/5A
PS-3030 ($224.95) 30V/3A
PS-6010 ($209.95)60V/10A
PR-3060 ($314.95)30V/6A
PR-6030 ($314.95)60V/3A

Digital Meters Display
PS-1830D($219.95)18V/3A
PS-1850D($244.95)18V/5A
PS-3030D($254.95)30V/3A
PR-6030D($399.95)60V/3A

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PPS-6020G ($1,099.95)
PPT-1830G ($1,399.95)
PPT-3615G ($1,399.95)

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FG-8015G($189.95)Sweep
- 0.02Hz-2Mhz,no counter
- Sine/Squ/Tri/pulse/Ramp

FG-8016G ($239.95)
- 0.02Hz-2MHz w/ counter
- Pulse, function generator

FG-8017G($249.95)Sweep
- Sine/Tri/Squ/TTL/CMOS
- 0.02Hz-2Mhz, FM mod.

FG-8019 ($399.95) Sweep
- 0.02Hz-2MHz w/counter
- INT/EXT AM/FM mod

FG-8019 ($209.95)
- 0.02Hz-2MHz w/counter

FG-8050 ($499.95) Sweep
- 0.05Hz-5MHz w/counter
- INT/EXT AM/FM mod

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- AC/DV(V,A),C,Ω,diode
- 1000V, 20A, 0.5% accu.

DM-8040($339.95) 3½ dgt
- ACV to 50kHz, true rms

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- dBm,auto,REL, min/max

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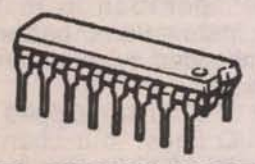
Write in 170 on Reader Service Card.

WANTED: ELECTRICAL materials, Allen-Bradley, Agastat, Appleton, Crouse-hinds, T&B, Square D, Pyle National, Russel & Stoll, circuit breakers, fuses, connectors. Call Beiner Sales, 805-376-9044, FAX 805-376-8207.

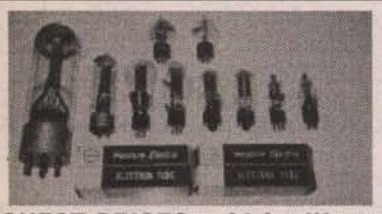
EXCESS INVENTORY WANTED: Transistors, semiconductors, capacitors, PC boards, & diodes. We buy it all!! Contact: **SEMITECH, INC.**, 381 Roberts Road, Oldsmar, FL 34677. Phone 813-854-3311, FAX 813-854-3422.

WANTED: ELECTRON tubes, ICs, semiconductors. Astral, PO Box 707NV, Linden, NJ 07036. Call 1-800-666-8467.



WANTED: EXCESS ELECTRONIC INVENTORIES, ICs, MEMORY, EPROMs, PALs, LEDs, CIRCUIT BOARDS, DIODES, AND TRANSISTORS. CALL ACTIVE MICRO, 562-494-4851 OR FAX 562-494-4913.

WANTED: TUBES, radios, transmitters, receivers, gyros, bearings, connectors, relays, lamps, synchros. Hyness Company, 709B Delair Road, Cranbury, NJ 08512-4212. Phone: 609-395-1116, FAX 609-395-1117.



HIGHEST PRICES paid for Western Electric tubes, new and used. Call Don Singerhouse/Singerhouse Sound. Toll free 1-888-715-tube.

BUYING USED and excess memory, EPROMs, circuit boards, etc. SMA 812-849-0007 fax lists 812-849-4035.

WANT USED or surplus DC motor controls or adjustable frequency AC drives, 1/2 HP and up. DC motors fractional to 3 HP. C. Woodruff, 5507 55th Ave. So., Seattle, WA 98118. Voice/Fax 206-723-8487.

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NUTS & VOLTS MAGAZINE
NEW PRODUCT EDITOR,
430 PRINCELAND CT., CORONA, CA 91719

OP6400 TOUCH-SENSITIVE BACKLIGHTED OPERATOR INTERFACE

Z-World announces the release of a new touch-sensitive user interface display. Ideal for machine control, embedded systems, and OEM applications, the new OP6400 displays user-defined graphics on a bright, touch-sensitive screen. The OP6400 can store up to 400 user-specified screens, each having up to 48 software "buttons" or locations on the touchscreen that are defined to be active.

The OP6400 is designed so the OEM or user can easily create command sequences, or "script," and graphical screens using readily available word processing and paintbox tools, such as PC Paintbrush, NotePad, or Microsoft Word. DOS and Windows platforms are supported by the OP6400 software. Scripts and screens are stored in local memory for rapid recall. In addition, the unit will accept both binary and ASCII commands from host PCs or other control devices.

The OP6400's 256x128 graphical LCD and 15x15 touch-sensitive transparent matrix can sense "presses" and "releases" by a user. The touchscreen communicates with any Z-World controller or PC through an RS-232 port. Screw terminals on the OP6400 facilitate easy wiring to a PC or Z-World controller. Communication baud rates range from 600 to 57,600 bps, making it virtually a universal display. User screens and scripts may be recalled automatically on system power-up.

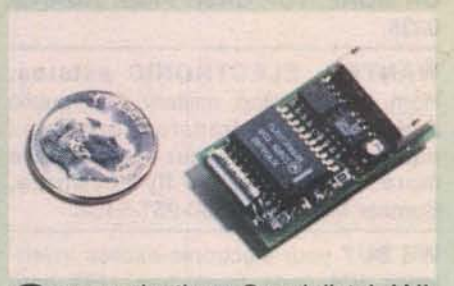
The size of the OP6400 makes it ideal for embedding into systems that are tight on mounting space. The unit may be either flush mounted using a bezel and gasket for a NEMA rating, or directly mounted in a cabinet with cutout.

The OP6400 is available with a development kit that includes a reference manual, serial cables, programming cable, wall power supply, and software diskette including sample programs. The OP6400 is available from stock, and is priced from $756.00 each.

For more information, contact:

Z-WORLD
2900 SPAFFORD ST., DEPT. NV
DAVIS, CA 95616
916-757-3737 FAX: 916-753-5141
E-MAIL: zworld@zworld.com
WEB: www.zworld.com

ANI-1 MINIATURE ANI ENCODER



Communications Specialists' ANI-1 miniature ANI encoder is a microprocessor-based PCB that provides instant identification of mobile and portable two-way radios.

The ANI-1 uses a high-speed multi-tone sequence for data transmission on an RF channel. Incoming unit ID and status message transmissions can be decoded and displayed on a personal computer by using the ANI-2 station decoder. It is compatible with links and repeater systems.

The ANI-1 measures 1.13 x .66 x .22 inches with easy interface connector.

The ANI Automatic Numbering Identification System is available from stock and carries a five-year warranty.

For more information, contact:

COMMUNICATIONS SPECIALISTS, INC.
426 W. TAFT AVE., DEPT. NV
ORANGE, CA 92865-4296
714-998-3021 FAX: 714-974-3420
1-800-854-0547

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The lowest radio frequency to which most people will ever tune is 530 KHz on their car's AM radio dial. The cassette tape VLF RADIO! goes beyond this barrier with sound samples from virtually every type of radio signal that can be heard on longwave and below.

This 60-minute cassette provides narration and actual recordings of ships at sea, non-directional beacons, European broadcasters, experimental lowfers, military radioteletype stations, WWVB, 10-14 KHz Omega, and natural radio.

Many of these signals are considered "endangered species" and have been preserved here for their historical value. Included with the tape are reference notes, a longwave spectrum chart, and a listener logsheet. VLF RADIO! is designed to serve as an introduction for the newcomer or as a reference tool for the seasoned DXer.

Tapes are available for $11.95 each postpaid (US funds).

For more information, contact:

KEVIN CAREY
P.O. BOX 56, DEPT. NV
WEST BLOOMFIELD, NY 14585
E-MAIL: kcarey@mdsroc.com

CABLE AND HARNESS TESTER

The CableEye® Model M2 PC-Based Cable Tester lets users find defective cables instantly, display a wiring diagram, highlight the error or defect in color, save wiring notes and labels with text, print schematics, and much more.

Featuring a compact fixture with 152 test points which can be cascaded to achieve up to 1,000 test points, this unit connects to a PC or laptop via a serial port for testing complex cables and wiring harnesses.

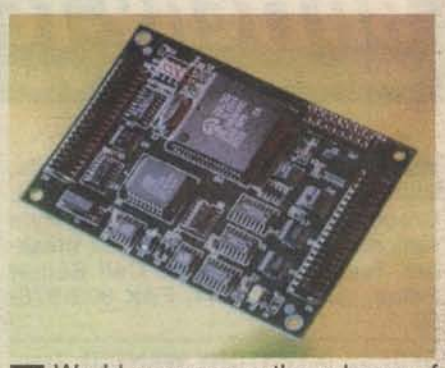
Supplied with menu-driven software and an on-line database which holds an unlimited number of user cables and includes descriptive notes and label text for each one, the CableEye Model M2 PC-Based Cable Tester can be set up for one-button operation to easily execute complex test sequences. Unlike stand-alone benchtop testers, this unit takes advantage of a PC's high-resolution graphic output to provide ISO-9000 documentation.

The CableEye Model M2 PC-Based Cable Tester sells for $1,595.00 with 152 test points and software.

For more information, contact:

CAMI RESEARCH, INC.
442 MARRETT RD., DEPT. NV
LEXINGTON, MA 02173
781-860-9137 FAX: 781-860-9139
E-MAIL:
sales@camiresearch.com
WEB:
http://www.camiresearch.com

LP3100 LOW-POWER C-PROGRAMMABLE CONTROLLER



Z-World announces the release of a low-power C-programmable controller. The new LP3100 is ideal for applications where available maximum voltage and current are low. The LP3100 operates on 3.3 volts and consumes only 16 mA, drastically minimizing operating power. The LP3100 is perfect for reliable operation in mobile or remote installations, battery-powered embedded systems, and OEM applications.

The LP3100 is equipped with 20 digital I/O lines, four channels of conditioned 12-bit analog input, two RS-232 serial channels, an RS-485 port, 512K flash memory, a real-time clock and calendar, and an LPBus expansion port. The unit will operate on input power in the range of 3.5VDC-24VDC. The LPBus expansion port facilitates the addition of user-designed boards for direct use with the LP3100 controller.

The LP3100 is equipped with a sleep mode that shuts down the unit to conserve power. Sleep mode is invoked by software, and the real-time clock can be used to "wake-up" the LP3100 at a future date or time. The sleep mode will reduce the required current to 200 microamps.

The four channels of conditioned 12-bit analog inputs allow interfacing to a wide variety of analog sensors. Offset and gain of each analog channel is user-configurable. The 20 digital I/O lines can be configured in several combinations of inputs and outputs. A real-time clock and calendar allow time-date stamping of critical data. Daylight savings and leap year compensation are user programmable — ideal for remote applications. The LP3100's compact size — it's only 2.5" wide x 3.5" long x 0.5" thick — allows embedding into the tightest of

New Product News

spaces.

The LP3100 is available with a development kit that includes a reference manual, serial cables, programming cable, wall power supply, development board, 2x20 LCD, and mounting plate.

The LP3100 is available from stock. The unit is priced from $119.00 each.

For more information, contact:

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2900 SPAFFORD ST., DEPT. NV
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916-757-3737 FAX: 916-753-5141
E-MAIL: zworld@zworld.com
WEB: www.zworld.com

SURGE SUPPRESSOR

This surge suppressor has modem/fax protection. It provides surge and noise suppression for both equipment power line and telephone line input. Suppresses up to 360 joules. It also handles up to 27,000A spikes.

Included are six electrical outlets and a 3-1/2 foot power cord. RFI/EMI line noise filtering exceeds 20 dB at 1 MHz.

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jensen@stanleyworks.com
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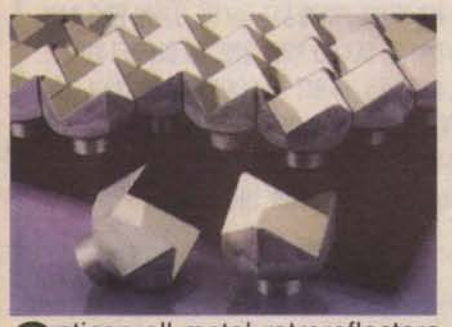
http://www.jensentools.com

OPTICON ALL-METAL RETROREFLECTORS AND ARRAYS



Opticon all-metal retroreflectors feature monolithic cast aluminum construction with tapped holes for bolt-in-place mounting to create arrays on back plates, cylinders, and in enclosures. Providing up to four times greater thermal stability than glass, they can be manufactured in virtually any shape with a 1/2" to 2" aperture and incorporate UV-VIS-IR coatings.

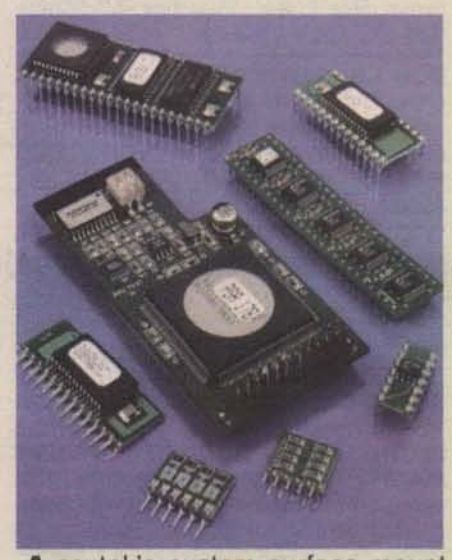
Ideally suited for demanding field applications, motion systems, and aerospace environments, Opticon all-metal retroreflectors and arrays are capable of withstanding up to 50,000 Gs shock while maintaining alignment. These truly monolithic individual hollow cube-corner and roof prisms exhibit up to two arc-second surface accuracy and one-quarter wave surface flatness.

Opticon all-metal retroreflectors are priced according to size, quantity, and design requirements.

For more information, contact:

OPTICON CORP.
76 TREBLE COVE RD., DEPT. NV
NORTH BILLERICA, MA 01862
978-663-6105 FAX: 978-663-0015

SURFACE MOUNT MODULES



Accutek's custom surface mount modules can be designed to solve space and volume constraints, enhance socket functionality, or replace end-of-life and obsolete parts. Typical modules include resistor terminators, RC filters, op amps, analog mutiplexers, digital logic circuits, CPUs, and memory circuits in DIP, ZIP, SIP, QUIP, SIMM, pin grid array, and mezzanine packages.

Capable of 48-hour turnaround depending upon surface mounting integrated circuits, discrete semiconductors, passive components, and connectors on FR4 substrates. End-of-life or hard-to-find monolithic ICs and modules can be reconfigured using readily available products and used as drop-in replacements.

For more information, contact:

ACCUTEK MICROCIRCUIT CORP.
2 NEW PASTURE RD., STE. 1
DEPT. NV
NEWBURYPORT, MA 01950-4054
978-465-6200 FAX: 978-462-3396
1-800-652-7505
E-MAIL: accutek@seacoast.com
WEB:
http://www.accutekmicro.com

ISOLATED TRANSCEIVER MODULE HYC3030

Shoreline Electronics, Inc. announces the HYC3030. The HYC3030 isolated transceiver module was designed specifically to handle noisy networking environments. The HYC3030 was also designed for extremely close node-to-node distances, without the usual reflection problems. The HYC3030 is a hybrid module that incorporates both a transformer for isolation and a custom IC to filter out noise.

The HYC3030 was specially designed to work in noisy environments like factory automation or industrial machines. A custom IC was incorporated in the design of the hybrid to filter out the noise.

The HYC3030 will support a node-to-node distance of only 50 cm at 312.5 KHz with minimal reflection between nodes. This is especially useful if networked machines have to be close together in a assembly line, POS terminals, or gaming machines.

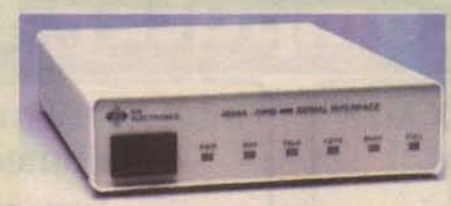
For maximum safety an isolation transformer is incorporated in the hybrid circuit. The transmission speed can be increased to 5.0 MBs if the distance between the nodes is increased.

The HYC3030 is designed to be a drop-in replacement for existing industry standard isolated hybrid module HYC2488. It was also designed to be compatible with industry standard protocols, Arcnet, Ethernet, Carnet, RS-232, and RS-485.

For more information, contact:

SHORELINE ELECTRONICS, INC.
2098B WALSH AVE., DEPT. NV
SANTA CLARA, CA 95050
408-987-7733 FAX: 408-987-7735

NEW ENHANCED GPIB <-> SERIAL INTERFACE



ICS Electronics announces a new GPIB-to-Serial interface with expanded features. These new features give the user an expanded range of baud rates and better control of the serial interface for operation with RS-485 networks. The Model 4894A operates as a GPIB interface for serial devices and as a Serial-to-GPIB controller for a single GPIB device.

ICS has redesigned their GPIB <-> Serial Interface Module to make it compatible with the higher baud rates used in todays modems and in other serial devices.

The new Model 4894A lets the user select any standard serial rate from 50 to 115.2 Kbaud. The user can also enter any non-standard baud rate and the 4894A will provide the closest baud rate based upon its 14.746 MHz internal oscillator. This feature assures that the 4894A will always be compatible with new serial devices.

Another new command lets the user select full or half duplex operation for controlling RS-485 networks.

The Model 4894A is CE certified for sale in Europe. Price starts at $475.00 each.

For more information, contact:

ICS ELECTRONICS
473 LOS COCHES ST., DEPT. NV
MILPITAS, CA 95035-5422
408-263-5500 FAX: 408-263-5896
INTERNET: www.icselect.com

PK2400 C-PROGRAMMABLE CONTROLLER

Z-World announces the release of a C-programmable controller with built-in graphic display and keypad. The PK2400 is ideal for machine control, embedded systems, and OEM conrol applications that require a controller with built-in operator interface.

The PK2400 offers nine protected digital inputs, two conditioned analog inputs, six high-current outputs, two non-latching relays, two serial ports, graphic LCD, and 20-key keypad with three additional softkeys. The 128 Kbytes of non-volatile flash memory allows hassle-free in-system programming.

The keypad is constructed of membrane switches with snap-domes, offering tactile feedback to the user. The three softkeys are software programmable, allowing custom input prompts. The number and letter legend on the 20-key keypad can be easily changed to fit the needs of the user and the application.

The size of the PK2400 makes it ideal for embedding into systems that are tight on mounting space or those that require a slim package. The PK2400 measures just 8.25"L x 4.5"H x 1"W. The PK2400's wiring terminals make it easy to connect directly to photosensors, temperature and pressure sensors, strain gauges, and a variety of other sensing devices.

For more information, contact:

Z-WORLD
2900 SPAFFORD ST., DEPT. NV
DAVIS, CA 95616
916-757-3737 FAX: 916-753-5141
E-MAIL: zworld@zworld.com
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Continued on page 106

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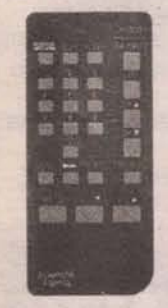

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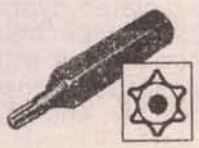

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Intel Pentium P200MMX MZH Multimedia System
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Mid TW. CASE, MB W/VX CHIPS 512 CACHE, 32MB EDO RAM, 2.5 GB HARD DRIVE, 16X CD ROM, 2MB 64 BIT PCI VIDEO CARD, 3.5" 1.44MB FD, 16 BIT 3D SOUND CARD, 33.6 FAX MODEM WITH VOICE, WIN 95 MOUSE, WIN 95 104 KEYBOARD, 80 WATT SPEAKERS, WIN 95 REL. 2, 14" SVGA MONITOR INCLUDED
$1499

Intel Pentium P233MMX MZH Multimedia System
Systems include:
Mid TW. CASE, MB W/VX CHIPS 512 CACHE, 32MB EDO RAM, 3.5 GB HARD DRIVE, 16X CD ROM, 2MB 64 BIT PCI VIDEO CARD, 3.5" 1.44MB FD, 16 BIT 3D SOUND CARD, 33.6 FAX MODEM WITH VOICE, WIN 95 MOUSE, WIN 95 104 KEYBOARD, 80 WATT SPEAKERS, WIN 95 REL. 2, 14" SVGA MONITOR INCLUDED
$1775

Also: 266 MZH System Available at Similar Savings! See AD MART

800-804-6552 All Software Loaded & Tested

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Don Lancaster's

RESOURCE BIN

number seventy five

Shattering a few virtual reality illusions.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals, and off-the-wall networking on nearly any electronic, *tinaja questing*, personal publishing, money machine, or computer topic by calling me at **(520) 428-4073** weekdays 8-5 Mountain Standard Time.

I'm now in the process of setting up my new *Guru's Lair* web site you will find at (where else?) www.tinaja.com. This is the place you'll go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns. Plus a brand new *Research InfoPack Service*.

You will get the best results if you have both *Netscape Communicator* and Acrobat Reader 3.0 installed.

Virtual Reality Today

There is a company called *Doron* at www.doranprecision.com who is the leading purveyor for the high school driver's education auto simulators. These folks have long since branched out into delivering multi-passenger motion simms to arcades, museums, science centers, and similar venues.

These are typically a "short subway car" looking beastie up on hydraulic stilts. A dozen passengers watch high definition videos while they subject themselves to total surround sound, motion simulation, and related special effects of one kind or another.

Our local *Museum Of Discovery* has one. It's recently been reprogrammed by the incredible Leonard Wikberg III of *DigitalLight* (www.digialight.com) in Flagstaff, AZ to create a spectacular solar system tour. You'll start off by dropping through the museum floor, riding up nearby Mount Graham, and circling their VAT optical and SMT radio telescope facilities.

From there, it is literally off to the moon, followed by a grand tour of the entire solar system. Fully detailing one planet and asteroid or whatever at a time. Much of the content here is real planetary footage gotten from JPL, NASA, and elsewhere. This has been seamlessly combined with utterly amazing new computer animation.

I was commenting to Leonard how some of those fractal landscapes on Venus looked overstated to the point of being too obviously fake. But he assured me that all of his Venusian Fractals were quite real. It seems their only enhancement was his modest resolution improvement of the actual flyby footage. I'll keep the ride ending a secret, except to say that it happens rather suddenly and unexpectedly.

The term "virtual reality" can have many meanings, and it is real hard to get a grasp on what is important and what is not. It is even harder still to separate what is possible today from the absolute hype.

I'll call virtual reality the creating of an artifical environment that's used to immerse one or more individuals in a simulation task. Perhaps for design, fun, training, medicine, or profit.

NEXT MONTH:
Don looks into some home automation products and resources.

The VR task might be a video game such as a flight simulator or an "if it moves, kill it" slash and hack, or some more thoughtful *Riven* like adventure. Or a real flight simulator for fighters, jumbo jets, or even spacecraft. Or a walkthrough for a new architectural design. Or checking for any assembly interference in CAD/CAM models.

Or a tour of the town. Or dildonics. Or amusement park and arcade rides. Perhaps an *Omnimax* show. Or special effects for some movie or video. Or a realtor's catalog. Or the training for a surgeon or an eye specialist.

Or the web itself. Which is nothing but one huge virtual reality machine. For you never really go anywhere or do anything when you surf it.

Here's a random sampling of a few virtual reality resources ...

VR Publishing

This outfit seems to have a good bargain: For $29.00 total, they'll offer six booklets which include a 600 entry virtual reality resource directory, a 436 pager on desktop VR, a IRML primer, their special virtual reality report, a longer *VR Infomania* book, and some virtual reality cartoons.

Their url is www.vr-publishing.com. Included is info on homebrew VR, a glossary, free VR trade show listings, and useful industry links.

Web Sites

There's gazillions of virtual reality web sites. The big problem is sorting them all out. One very useful "link to links" site is *tin.ssc.plym.ac.uk/vr.html*. Two others include *www.sense8.com/resources/online_resources.html* along with *www.jmbe.com/vrpage.html*.

A virtual reality bibliography is in *www.cms.dmu.ac.uk/~cph/VRbib.html*. A lengthy summary of hot VR sites is in *www.itl.nist.gov/div894/ovrt/hotvr.html*.

An interesting glossary is online at *www.cyberedge.com/home/www/4al.html*.

There are dozens more where these came from. Try ...

groucho.gsfc.nasa.gov/eve/Links.html

www.fes.uwaterloo.ca/u/mdelfgaa/plan220/group1/links.html

www.vrworlds.com/more/vrlist.html

webster.skypoint.net/members/kht/html/vrlinks.htm

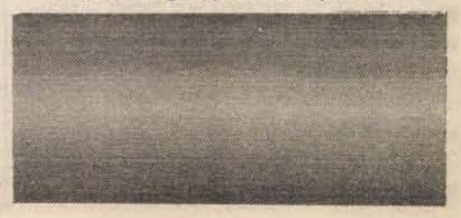
www.hitl.washington.edu/projects/knowledge_base/onthenet_list.html

The real trick lies not in finding VR info, but in getting it all sorted out so that it makes some sense to you.

3D Graphics

The center of the virtual reality universe appears to be 3D graphics. Such graphics are created as a data base of numeric values. You'll often start with an *armature* supporting a *wire frame* that's full of triangles or polygons. Or possibly use something fancier such as *Nurbs* cubic spline surfaces. Some cubic spline basics do appear in *www.tinaja.com/cubic01.html*. It is not at all unusual for an object to consist of many thousands, or even millions of polygons.

At rendering time, the wire frame model applies its *hidden line removal* algorithms to present only the aspect to be viewed. Surfaces are then added to the wire frame. These surfaces are then modified by



RESOURCE BIN

SOME VIRTUAL REALITY RESOURCES

Alpha FX
600 Harrison St
San Francisco CA 94107
(415) 358-9500

Basic Service Am Rides
PO Drawer 8150
Ruidoso NM 88355
(800) 366-3991

Cinefex
Box 20027
Riverside CA 92516
(909) 781-1917

Computer Aided Design
655 Americas Ave
New York NY 10010
(212) 989-5800

Computer Graphics World
10 Tara Blvd 5th Flr
Nashua NH 03062
(918) 835-3161

CyberEdge Journal
1 Gate 6 Rd
Sausalito CA 94965
(415) 331-3343

Design News
8773 S Ridgline Blvd
Highlands Ranch CO 80126
(617) 558-4342

Doron Precision Sys
174 Court St
Binghamton NY 13902
(607) 772-1610

Game Developer
600 Harrison St
San Francisco CA 94107
(415) 905-2200

Grainger
2738 Fulton St
Chicago IL 60612
(312) 638-0536

Hydraulics & Pneumatics
1100 Superior Ave
Cleveland OH 44114
(216) 696-7000

Intelligent Systems
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Atlanta GA 30339
(770) 431-0867

Machine Design
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Cleveland OH 44144
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McMaster-Carr
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Los Angeles CA 90054
(213) 692-5911

Measurement & Control
2994 W Liberty Ave
Pittsburgh PA 15216
(412) 343-9666

Mondo 2000
PO Box 10171
Berkeley CA 94709
(510) 845-9018

Motion Magazine
Box 6430
Orange CA 92613
(714) 974-0200

Museum of Discovery
1651 Discovery Park Blvd
Safford AZ 85546
(520) 428-8081

New Equipment Digest
1100 Superior Ave
Cleveland OH 44114
(216) 696-7060

New Media
901 Mariner's Is Blvd #365
San Mateo CA 94404
(415) 573-5170

PCIM
2472 Eastman Ave #33-34
Ventura CA 93003
(805) 658-0933

Power Transmission Des
1100 Superior Ave
Cleveland OH 44114
(216) 696-7648

Product Design & Dev
Box 945
New York NY 10159
(212) 633-7300

Sensors
174 Concord St
Peterborough NH 03458
(603) 924-9631

SIGRAPH/ACM
1515 Broadway
New York NY 10036
(212)626-0500

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4838 Ronson Ct
San Diego CA 92111
(619) 277-3888

Small Parts
PO Box 4650
Miami Lakes FL 33014
(305) 557-8222

Stewart
2356 Main Mall
Vancouver BC V6J 1Z4
(604) 822-2872

Sun Workstations
901 San Antonio Rd
Palo Alto CA 94303
(650) 960-1300

Synergetics
Box 809
Thatcher AZ 85552
(520) 428-4073

Telemedicine & VR
227 E Washington Sq
Philadelphia PA 19106
(800) 777-2295

VR Publishing
16486 Bernardo #378
San Diego CA 92128
(619) 485-5353

Virtual Reality Report
11 Ferry Ln W
Westport CT 06880
(800) 632-5537

Virtual Reality World
11 Ferry Ln W
Westport CT 06880
(800) 632-5537

Westrex
4545 E Industrial St #5B
Simi Valley CA 93063
(805) 520-2500

adding texture and color, by using specialized lighting algorithms or by literally growing fur, grass, or hair on them.

As you might guess, humongous computing power is required for a realistic rendering. *Sun* Workstations have been the norm, but ganged high end PCs are now starting to approach their capabilities. It is not unusual to spend 60 *hours* of computing per runtime *second* of rendering.

Some Magazines

The pricey *CyberEdge Journal* seems to be a leading magazine here. There's also a $29.00 yearly *Virtual Reality World*, and a $65.00 *Virtual Reality Now.*

Another useful pub is that superb *Game Developer*. Plus these guys ...

Alpha FX
CAD/CAM Update
Computer Aided Design
Computer Graphics World
Intelligent Systems Report
Mondo 2000
New Media
Retrograde Motion
Simulators
Telemedicine & Virtual Reality
Virtual Reality Report

More details on all these titles are in *www.tinaja.com/webwb01.html.*

There are also scads of multimedia magazines which are heavily into 3D graphics and touch on other virtual reality topics. We looked at these back in RESBN45.PDF, along with the video game tools and technique magazines of IRESBN65.PDF. Both of these can be found on *www.tinaja.com/resbn01.html.*

Many of these mags can be free to qualified subscribers.

Sigraph

One premier event for pretty near everything using computer graphics is the annual *Sigraph* conference, put on by those ACM people, short for the *Association for Computer Machinery.*

All the show proceedings are now available separately or included in the special issue of their quarterly *SIG Computer Graphics* publication.

Books

A well annotated review of all the major virtual reality books appears as the *CyberEdge Electric Best VR Books.* Found at *www.cyberedge.com/4bl.html.* A second useful listing is online at *www.smokefreekids.com/virtbook.html.*

Some of today's top virtual reality books include ...

Design of Virtual Environments
Experiments in Virtual Reality
How Virtual Reality Works
Information Sources for Virtual Reality
Possible Worlds: VR Social Dynamic
Virtual Reality Casebook
Virtual Reality Construction Kit
Virtual Reality Homebrewer's Handbook
Virtual Reality Systems

More info on these and other titles at *www.tinaja.com/amlink01.html.*

VRML

There is this fairly new computer language that is primarily intended for virtual reality extensions of the web. This ne is called VRML and is an acronym for *Virtual Reality Markup Language.* There's a lot of good VRML stuff on the web.

Some major new books on VRML include ...

3D Graphics and VRML 2.0
Advanced VRML Techniques
Annotated VRML 2.0 Reference Manual
Building 3D Worlds in Java and VRML
Building VRML Worlds
Creating Cool 3D Web Worlds with VRML
Creating your own VRML Web Pages
Delphi VRML for Internet Solutions
HTML, VRML, and JAVA Web Publishing
Java for 3D and VRML Worlds
Late Night VRML 2.0 with Java
Mecklemedia's Official Guide to VRML
Teach Yourself VRML 2 in 21 Days
Using VRML
Virtus VRML Starter Kit
VRML & 3D on the Web for Dummies
The VRML 2.0 Handbook
VRML 2.0 Sourcebook
VRML: Bringing Virtual Reality ...
VRML: Exploring Virtual Worlds ...
VRML: Flying through the web
VRML Clearly Explained
VRML Programmer's Library
Web Publishers VRML Quick Reference

You can get more info on any of these at *www.tinaja.com/amlink01.html.*

We have also seen above that *VR Publishing* has a concise 32-page *VRML Primer* book. And you should shortly discover a *comp.lang.vrml* newsgroup just below.

Newsgroups

There sure are a lot of newsgroups that involve themselves with virtual reality in one way or another. A few of these include ...

alt.3d
alt.cyberspace
comp.ai
comp.ai.games
comp.ai.philosophy
comp.cad.autocad
comp.graphics.algorithms
comp.graphics.animation
comp.graphics.misc
comp.lang.vrml
comp.multimedia
comp.graphics.visualization
comp.robotics.research
rec.aviation.simulators
rec.games.video.arcade
rec.video.desktop
sci.virtual.worlds
sci.virtual.worlds.apps

Mechanical Stuff

Besides *Doron*, a few of those other simulator manufacturers are *Stewart*, *Westrex*, and *Basic Service Amusement Rides*. A more complete list can be found in the above directories or via the *Thomas Register* link you'll find at *www.tinaja.com/webwb01.html.*

If you are interested in the actual design of simulators, rides, robots, tactile gloves, or whatever, your best starting point will often be the trade journals. As always.

Your biggies here include *Machine Design* and *Design News.* Individual bits and pieces are found in *Product Design and Development* and in *New Equipment Digest.* Also check *Design Engineering* and *Design Product News.*

Hydraulics and Pneumatics cover the obvious. Your robotic stuff is best found in *Sensors*, *Power Transmission Design*, *Measurement & Control*, *PCIM*, or *Motion* magazines.

The all time greatest place for small parts is, of course, *Small Parts.* Helped along by the usual *W.W. Grainger* and *McMaster-Carr.*

Your really big thing these days in motion platforms is called the *inverted hexapod.* These newly see major use in everything from milling machines to simulators. These are just six pivoted push or pull struts whose combined motions determine the head or pod movement.

All actions are simple extensions or compressions; you will find zero side loading and nothing whatsoever that resembles a precision way or a sliding friction surface.

Finally, the special effects goodies used by the movie magic folks is a secret industry all to itself. Their little known trade journal is *Cinefex.*

This Month's Contest

For our contest this month, just tell me about any virtual reality resource I may have missed out on.

Or, better yet, how about com-

ing up with a brand new virtual reality concept, use, or application. With all of that humongous new computing power available these days, and super web access to pretty near anything, there should be all sorts of new apps you can dream up.

I still strongly feel there are all sorts of potential new VR uses for lower pressure pneumatics. Actuated with simple bladders, rolling diaphrams, or bellows. Power can be easily done with an aquarium air pump. And control can be as simple as a low-cost automotive TCS or SCS three-way valve. More details on such valves at *http://www.tinaja.com/barg01.html*.

Another emerging new VR area involves tactile feedback. With gloves or surfaces that "push back" or let you "feel texture." Piezo microactuators might be one route here. Free samples from *Amp Piezo*.

The tactile problem lies in real-time management of zillions of actuators, each of which has to be very fast responding, low in cost, and provide an effect that is both realistic and safe.

Lots of possibilities here.

There should be a largish pile of my new *Incredible Secret Money Machine II* going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two that will go to the very best of all.

Send all your *written* entries to me here at *Synergetics*, rather than to *Nuts & Volts* editorial.

For More Help

Additional hot-linked VR content is found in *www.tinaja.com/resbn01.html*, while VR book access links are found at *www.tinaja.com/amlink01.html*. The VR magazine sources can be reached through *www.tinaja.com/webwb01.html*. Customized and personal consulting services for VR or nearly any other technical topic are reachable by way of *www.tinaja.com/info01.html*. **NV**

*Microcomputer pioneer and guru Don Lancaster is the author of 35 books and countless tech articles. Don maintains his no-charge US tech helpline found at **(520) 428-4073**, besides offering all of his own books, reprints, and consulting servicesl. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time.*

Don is the webmaster of his Guru's Lair found at http://www.tinaja.com

*Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at **Synergetics**, Box 809, Thatcher, AZ 85552. Or send any messages to his US Internet address of **don@tinaja.com***

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http://www.dontronics.com is DonTronics Home Page. Hardware: Atmel and PIC microcontroller prototype and development boards, programmers, SimmStick™. **Software:** BASIC Stamp II Windows 95 Front End, AVRBasic for the AT90S1200, BascomLT for the AT89C2051, multi-media "Pacman-like" tutorial for the PIC16F84, and lots more.

COMPLETE 68HC11 SBC with controller area network, LCD, RS232. Download programs to 32K flash. Plugs into solderless breadboard for rapid prototyping, great learning tool, $175. **CANPORT: Connect PC to controller area network.** Includes DLLs, libraries, application, $89. Order: EMICROS, 25759 Ridgewood, Farmington Hills, MI 48336. 248-477-6639. Info: **www.emicros.com**

COMPACT 68HC11 microcontroller 32K, RS232, LCD interface, compatible with interactive C, for your robotic and custom control applications. Bare PCB $20, kit $95 or assembled $145. Embedded Acquisition Systems, http://www.hooked.net/~jfong

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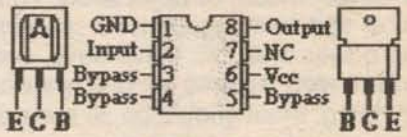

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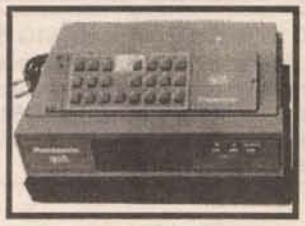

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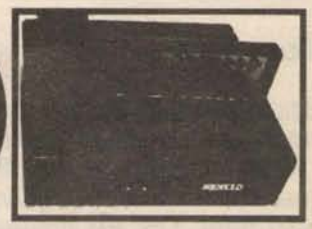

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Events CALENDAR

Continued from page 44

MI - GROSSE POINTE WOODS - South Eastern MI ARA Hamfest. Thom Duggan WA8RLI, 810-777-2443. E-Mail: wa8rli@juno.com
MI - KALAMAZOO - Super Computer Sales. Wings Stadium, 3600 Vanrick Dr. 10am-4pm. Computers And You 734-283-1754
NY - POUGHKEEPSIE - Mt. Beacon ARC Hamfest. Ken Akasofu KL7JCQ, 914-485-9617
OH - ATHENS - ARA Hamfest. Drew McDaniel W8MHV, 614-592-2106. E-Mail: mcdanied@oak.cats.ohiou.edu Web: http://www.seorf.ohiou.edu/~xx017/hamfest.html
OH - CANFIELD - Hamfest & Computer Flea Market. Canfield Fairgrounds, Rt. 46. 8am-3pm. Don Stoddard N8LNE, 330-793-7072
PA - WILKES BARRE - Computer Show. Genetti's Best Western. 9:30am-4pm. MarketPro 301-984-0880
VA - ANNANDALE - Computer Show. Northern VA Community College. 9:30am-4pm. MarketPro 301-984-0880
VA - ROANOKE - Computer Show. Roanoke Civic Center. 9:30am-4pm. MarketPro 301-984-0880

MAY 1998

MAY 1-2

LA - BATON ROUGE - Hamfest & Computer Show. Fri. 5pm-9pm. Sat. 8am-4pm. Herb Ramey W5LSU, 504-654-6087. E-Mail: W5GIX@aol.com Web: http://members.aol.com/w5gix/index.html

MAY 1-2-3

CA - VISALIA - International DX Convention. Rick Samoian W6SR, 714-993-0713 or 310-616-3912

MAY 2

AL - MOULTON - Hamfest. H. A. Alexander Park. 9am-5pm. Lee Creuzer N8MHC, 205-584-0111. E-Mail: N8MHC@AOL.COM
AZ - SIERRA VISTA - Cochise ARA & SE Hamfest. Ronald Slominski KC7QXJ. 520-378-3018
CA - BAKERSFIELD - Computer Show. Kern Co. Fairgrounds. MarketPro 415-456-6730. Web: http://marketpro.com
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CO - COLORADO SPRINGS - Pikes Peak RAA Hamfest. Phil Pearsall KC5LXC, 719-531-5319. E-Mail: pearsall@msn.com
CO - GRAND JUNCTION - Western CO ARC Hamfest. Diana Dodd KB0REW, 970-243-7441
KY - OWENSBORO - ARC Hamfest. George Stokes KD4CKT, 502-683-2169. E-Mail: w4nho@occ-uky.campus.mci.net
MD - GRASONVILLE - Anne Arundel RC & Kent Island ARC Hamfest. Glenn Durbin WN3G, 410-643-1125. E-Mail: K3ORC@amsat.org or pvtpilot@friend.ly.net
MI - CADILLAC - Hamfest. Cadillac Middle School. 8am-1pm. Dan KE8KU, 616-775-0998. E-Mail: ke8kudan@juno.com
MN - DULUTH - Arrowhead RAC Hamfest. Bud Fisher KB0SBL, 218-879-9284. E-Mail: kb0sbl@cp.duluth.mn.us
NC - GASTONIA - ARC Hamfest. Lynn KD4CDP, 704-735-2197
NH - SEABROOK - Computer Show. Seabrook Greyhoud Racetrack. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
NY - OWEGO - Hamfest. Marvin Park Fairgrounds, Rte. 17C. 8am-4pm. BARA, POB 853, Binghamton, NY 13902. E-Mail: owego98@ibm.net Web: http://www.wtsn.binghamton.edu/bara
RI - SMITHFIELD - City Slickers Radio Operators. Frank Grzych KE1FJ, 401-231-3993 E-Mail: cobra@ibm.net
SC - ELKO - Tailgate Party. Rosewood Farm. 9am-4pm. Bill Wetzel W4OXA, 803-245-5522.
WI - CEDARBURG - Ozaukee RC Hamfest. Gabe Chido, 414-377-2784 or 414-284-3271
WI - SUPERIOR - Arrowhead RAC Hamfest. Jeff Daniels N0VQF, 218-485-8131

MAY 2-3

CA - VALLEJO - Computer Show. Solano Co. Fgrds. MarketPro 415-456-6730 Web: http://marketpro.com
GA - LAWRENCEVILLE - Computer show. Gwinnett Fairgrounds. Georgia Mountain Productions 706-838-4827
TX - ABILENE - Hamfest. Civic Center. Sat: 8am-5pm, Sun: 9am-2pm. Peg Richard KA4UPA, 915-672-8889.

MAY 3

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
CA - SAN DIEGO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730. Web: http://marketpro.com
IL - SANDWICH - Kishwaukee ARC Hamfest. Bob Yurs W9ICU, 815-895-3219. E-Mail: mailto:n9zna@aol.com Web: http://tbcnet.com/~jleonard/hamfest.htm
MD - HAGERSTOWN - Hamfest. Junior College Athletic and Recreation Community Center. 8am-3pm. Donald Jones KB8WHW, 304-728-7769. E-Mail: kb8zqm@intrepid.net
ME - LEWISTON - Computer Show. Central Maine Civic Center. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
NY - YONKERS - Flea Market. Lincoln High School. Kneeland Ave. 9am-3pm. Otto Supliski WB2SLQ. 914-969-1053
PA - WRIGHTSTOWN - Warminster ARC Hamfest. Tony Simek N3YNH, 215-674-5218
WV - RIPLEY - Jackson Co. ARC Hamfest. Gary Casto AG8RY, 304-372-2849. Web: http://jackwv.simplenet.com/jcarc/index.html

MAY 8-9

NH - ROCHESTER - HOSSTRADERS Hamfest. Joe Demaso K1RQG. 207-469-3492. E-Mail: k1rqg@aol.com

MAY 9

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CO - GRAND JUNCTION - Western CO ARC Hamfest. Diana Dodd KB0REW, 970-243-7441
NH - MANCHESTER - Computer Show. Center of NH Expo. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
OK - EUFAULA - McIntosh Co. ARC & Pittsburg Co. ARC Hamfest. John Petersen KM5ES, 918-452-2279. E-Mail: km5es@eufaula.lib.ok.us
OR - HILLSBORO - Portland ARC Hamfest. Marilyn Lum KJ7AY, 503-236-4463. E-Mail: KJ7AY@juno.com
SC - GREENVILLE - Blue Ridge ARS Hamfest. Gene Owensby WB4ZBZ, 864-476-2609
WA - STANWOOD - Stanwood-Camano ARC Hamfest. Vic Henry N7KRE, 360-387-7705
WI - MANITOWOC - Hamfest & Computer Swapfest. Manitowoc County Expo Center. 8am-12pm. Glenn M. Debaker AA9MT, 920-684-7096. E-Mail: gdebaker@lakefield.net

MAY 9-10

CA - SACRAMENTO - Computer Show. Cal Expo. MarketPro 415-456-6730 Web: http://marketpro.com

MAY 15

OH - KETTERING - Annual Banquet. Alex's Continental Restaurant. Robert Dingle KA4LAU.

Continued on page 104

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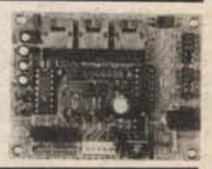

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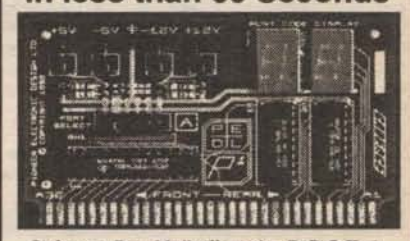

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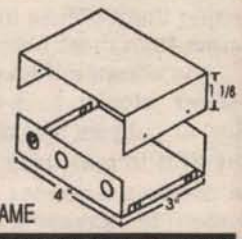

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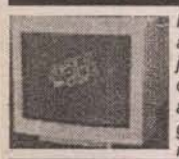

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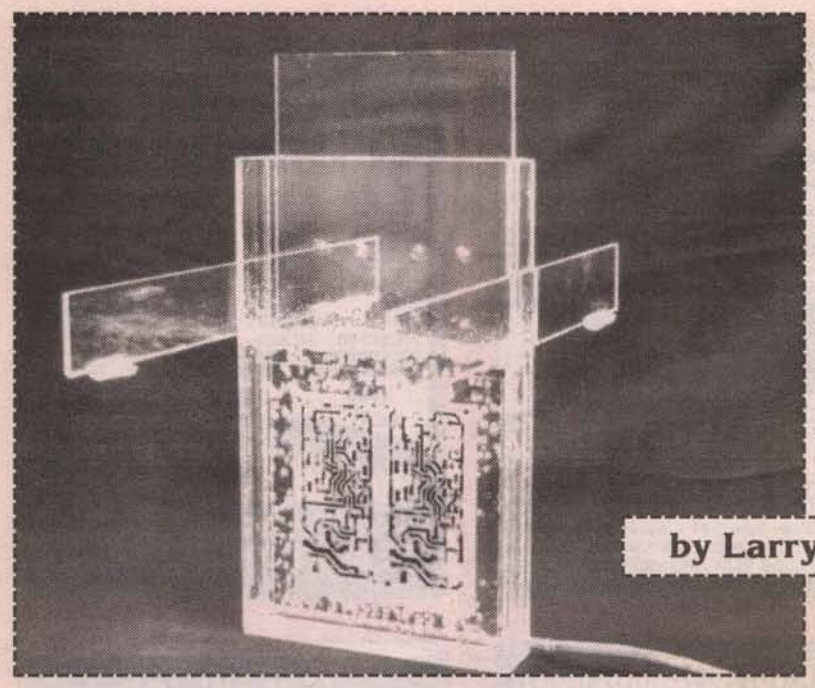


Build a "Super" Etching Tank

Etch Printed Circuit Boards Faster and Conserve Etchant at the Same Time!

by Larry Ball

As anyone who's used an etching tray knows, sloshing etchant over copper is a poor way to make printed circuit boards. A "real" etching tank is faster, and far more convenient. For even more convenience, ammonium persulphate should be used with the tank. It's less messy than ferric chloride and has the advantage of letting you watch the etching cycle progress.

Unfortunately, once mixed, it has a limited shelf life, and due to the high volume of many "store bought" etching tanks, it often loses its potency before it's used up. Now you can have the low volume (and low waste) of the tray, and the convenience and speed of the tank. Not only that, you can build it yourself for less than the price of a "store bought" tank.

Build a "super" etching tank! It requires one-tenth the etchant of many "standard" etching tanks and it's faster!

The low volume of etchant required by the "super" etching tank will save you money, and the tank's innovative design will save you time. This is because it forces rising bubbles around your PCB, rather than letting them diffuse in a tank much larger than most people need.

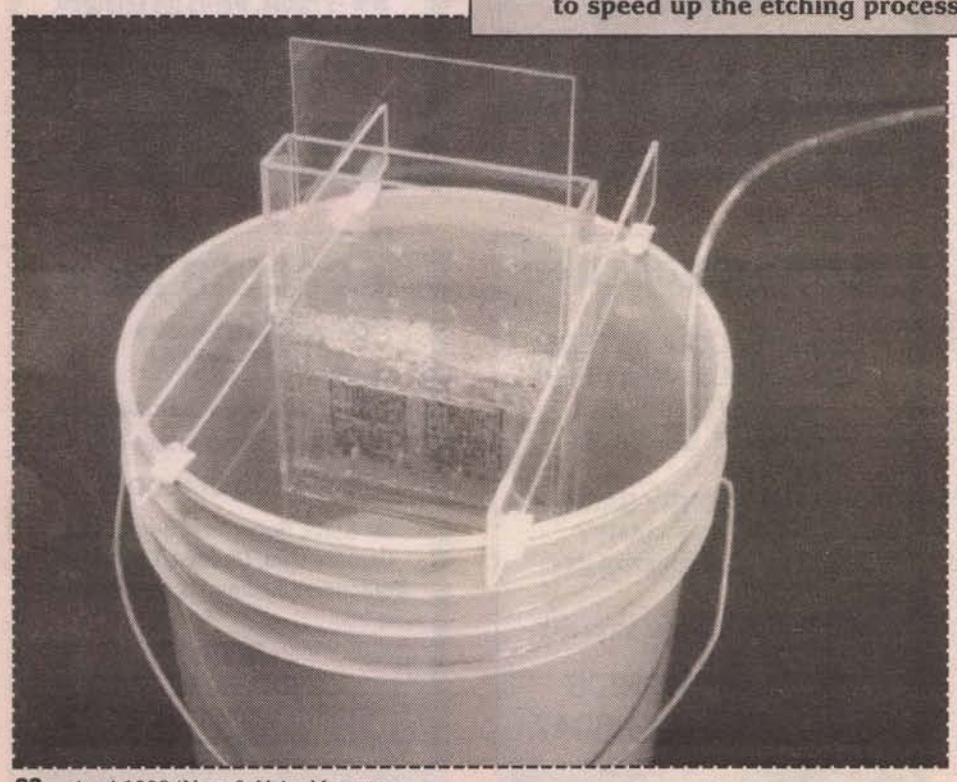
As shown in Figure 1, the "super" etching tank channels the flow of bubbles and etchant around the PCB to maximize etching speed. In addition, it creates a circular flow pattern to increase the overall flow rate.

You've probably noticed that PCBs etch faster where the bubbles contact them the most; the "super" etching tank takes full advantage of this.

Once you've used this tank, you'll never want to use a "standard" tank again. The "super" etching tank can also eliminate the hassle and expense of installing a heater, since it's made to be used in a container of warm water — and the container can be as simple as an old aquarium or five-gallon bucket (Figure 2).

In this day and age of conservation, it's nice when you find a device that not only conserves, but does a better job as well.

Figure 2. Place the "Super" etching tank in a container of warm water to provide heat to speed up the etching process.



Description

As shown in Figures 3 and 4, the "super" etching tank consists of two parts: a carrier and a tank. The carrier holds the PCBs and allows you to conveniently place them in and remove them from the etchant. The tank holds the etchant and is suspended in a container of warm water which provides heat to speed up the etching process. If you use the tank for less than two hours, a heater isn't needed. If you use the tank for longer than that, you can use a heater or simply exchange the water in the outer tank with warmer water.

The "super" etching tank can comfortably etch PCBs up to 5 by 5-1/8 inches (while using a miserly two cups of etchant!) and, if needed, can etch PCBs up to 7 by 5-3/16 inches. A check of hobbyist electronics magazines shows that most PCBs are 5 by 6 inches or smaller (mostly smaller). The "super" etching tank was designed to accommodate these sizes. Of course, you can "custom size" the "super" etching tank to meet your particular needs.

The carrier and tank can be built for under $30.00 — including the air pump.

When you consider that "store bought" etching tanks cost $40-$80, and may continue to cost money by wasting etchant, this is quite a bargain.

Construction

The "super" etching tank is made of clear 1/8-inch thick acrylic plastic sheeting, which we'll refer to by a common brand name: "Plexiglas." The total amount of Plexiglas needed for the tank and carrier is two square feet, but you should get over three square feet to allow for practice, mistakes, etc. Additionally, you'll need a square, a straight edge, a drill, and a scoring tool.

Plexiglas is easy to work with, but some knowledge of how it's cut and fabricated is required. There are two basic methods of cutting plexiglas: sawing, and scoring, then breaking. Sawing is best done with a table saw and a special plastic cutting blade (which few people have).

With that in mind, we'll cover only scoring, then breaking (cutting a grove in the plastic, then breaking it along the grove). For this method, you'll need an acrylic plastic scoring tool. A razor knife is an extremely poor substitute.

The technique is simple, but you should practice it before making your etching tank. Plexiglas comes with a removeable paper backing. Begin by using a pencil and a combination square (or carpenter's square) to mark the backing all the way across a piece of Plexiglas. Use a straight edge for alignment and drag the scoring tool over your mark to make a grove in the Plexiglas sheet (Figure 5).

Figure 1. The "Super" etching tank forces bubbles and etchant over the PCB, then creates a circular flow pattern to increase the overall flow rate.

A light pressure is best for the first few passes, then a moderate pressure may be used. Do this about 6-10 times in one direction, then in the other direction. Score the grove at least one-half the thickness of the Plexiglas (narrow strips will need to be scored more deeply).

Place the sheet on a sturdy table with the grove upward and aligned with the table's edge. Pin the sheet down with one hand and a straight edge (Figure 6). Use the other hand to press down quickly and firmly on the section hanging off the table. The Plexiglas should break neatly.

After some practice cutting Plexiglas, you can begin making

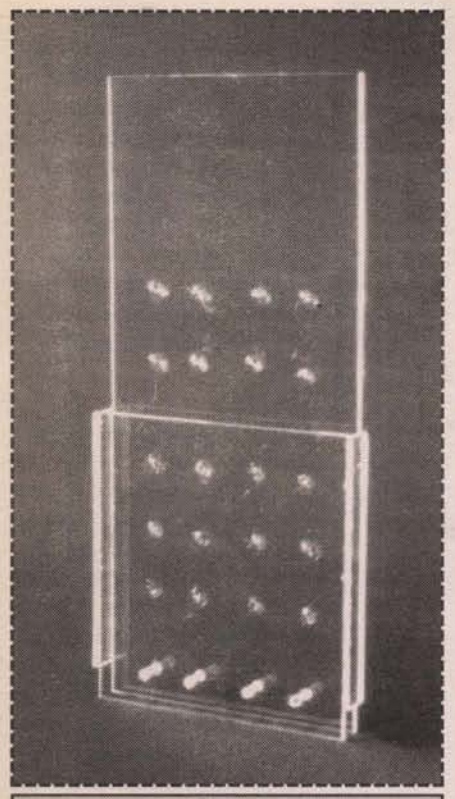


Figure 3. The carrier allows the PCBs to be conveniently placed in and removed from the etchant.

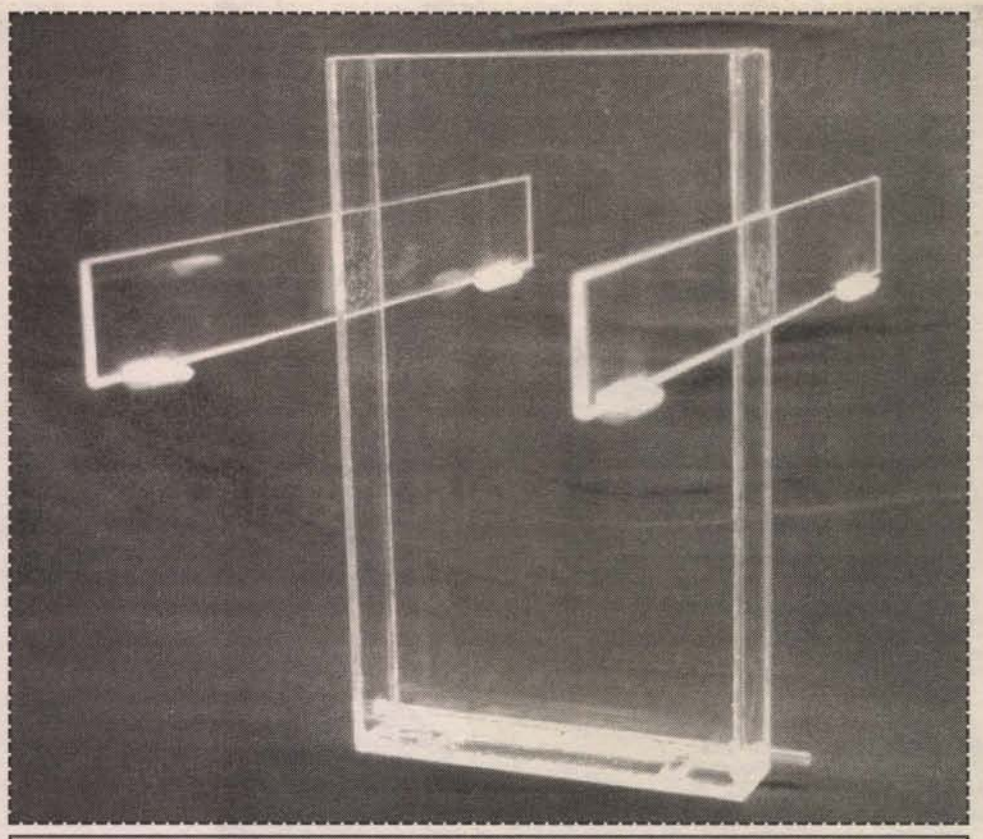


Figure 4. The "Super" etching tank can etch a 5-1/8 by 5 inch PCB while using only two cups of etchant! If needed, the tank can etch PCBs up to 7 by 5-3/16 inches.

your etching tank. When marking the material for cutting, you can save time and avoid waste by placing sections which are the same width side by side. Keep in mind that all cuts must be completely across the sheeting. Also, don't automatically assume the corners on your material are square. After cutting the parts, use a sanding block with 180 grit sand paper to remove any burrs or rough edges. A smooth, even edge is needed to avoid leaks.

Finally, drill pieces as shown in Figures 7 and 8. Use a variable speed drill; drill slowly and carefully without too much pressure. Practice drilling some scrap before drilling the carrier and tank.

Air Tube and Carrier Support Pins

As shown in Figures 4 and 8, bubbles are provided by a 6-3/4 inch section of 3/16-inch O.D. hard aquarium air tube.

Follow the pattern in Figure 8 to carefully drill the holes with a drill press and a #77 bit. Hold the tube perfectly stationary while drilling, and don't attempt to drill both sides at the same time (Figure 9). It may seem that the tiny bits break if you look at them wrong, but with a steady hand you can drill hundreds of holes with a single bit.

If you don't have access to a drill press, you can make the holes with a #10 sewing needle. Heat the tip red hot and use it to puncture the tube (it's easier to complete one side, then flip the tube over and complete the other side.) The melted bumps which form around the holes can be scraped off with a knife. You may have to repeat this process to make sure the holes are cleared, but be careful not to make them oversized.

After you've made the holes, use glue to plug the end opposite inlet. When the glue is dry, connect the tube to your air pump to test it; submerge the tube horizontally in six inches of water. If you've checked the tube to confirm all the holes are unobstructed, and bubbles still don't emerge from each and every hole, use a bigger air pump. DO NOT skip this step! The air tube should be tested *BEFORE* installation.

The carrier support pins are shown in Figures 3 and 7. Notice the wedge-shaped notches in them. These notches make the PCBs "self-centering." A file or razor knife can be used to cut them.

Assembly

Plexiglas may be glued with any glue made specifically for acrylic plastic. The best I've found is "Weld On #16;" it's thick, it "melts" the pieces together for an excellent bond, and it's fast setting, which speeds up the assembly process.

Once you've begun gluing, the assembly process is difficult to stop, so set aside a time when you won't be disturbed. Work on a flat, level, and uncluttered surface. If the assembly process is followed correctly (assuming the parts are cut correctly) the process is somewhat "self-squaring." However, a square is still needed, and at a minimum should be used to check your work before the glue sets.

Carrier Assembly

Before assembling the carrier, place a grid of evenly spaced 1/16-inch tall "glue bumps" on the inside back of the carrier (Figures 3 and 7). These bumps keep the PCB from sticking to the carrier via unwanted suction. They should be smooth and rounded rather than sharp and jagged (to avoid damaging the etch resist on double-sided PCBs). Since the glue will shrink, you'll need to apply several layers. Practice applying these bumps first, so you can get a "feel" for how to apply them neatly.

As shown in Figures 3 and 7, the sides of the carrier form caps over the front and back. Also note that the bottom edge of the sides is 5/8-inch above the bottom of the front and back.

Carrier assembly is as follows:

Rest one of the carrier sides on a flat surface. Apply a bead of glue to the side piece where the back will

Figure 5. Mark the pieces with a square and a pencil, then use a straight edge and scoring tool to make a grove one-half the material's thickness.

SIDEBAR

The air pump should be elevated above the level of the etching tank. If not, use an anti-backup valve on the air line, or you may find your pump in a puddle of etchant.

The stronger your pump is, the better. Two good reasonably priced air pumps are the "Apollo 3" and "Apollo 5," both sold at Wal-Mart.

If you choose to use a heater, get a 100-watt unit. If the etchant gets too hot, you can always turn a big heater down, but not vise-versa. In fact, on most heaters, you'll have to remove the adjustment knob so that you can force the heater to provide a higher temperature.

Occasionally, the carrier may "rattle" due to vibration caused by the bubbles. This doesn't hurt anything, but it can be annoying. You can eliminate the "rattle" by using an alligator clip to attach the top edge of the tank to the carrier's back.

Always mix ammonium persulphate etchant outside of the tank. This makes crystals of etchant clogging the air tube less likely. If the air tube does get clogged, it may be unclogged by forcing hot water through the air hose with a de-solder bulb.

Since it's difficult to predict how much potency is left in a batch of stored ammonium persulphate, you may want to mix a new batch each time the tank is used. The small volume of the "super' etching tank makes this an economical option.

When mixing ammonium persulphate, use 120 degree Fahrenheit water. The etchant dissolves poorly in cold water. This also eliminates waiting for the water in the outer tank to warm the etchant

Buy a real acrylic plastic scoring tool. Attempting to use a razor knife can result in untold frustration and wasted Plexiglas. Scoring Plexiglas is much easier with the proper tools and techniques.

join. Place the back piece into position on the side and hold it perpendicular to it until the glue partially sets. Apply another bead of glue to the side, where the front piece will join. Place the front into position and hold it until the glue partially sets. Apply glue beads to the remaining side, then join it to the other pieces. While the glue is partially set, but still soft, stand the carrier on its bottom to be sure the front and back plates line up squarely.

Let the carrier dry before installing the PCB support pins. The pins fit into the carrier as shown in Figures 3 and 7. Insert the pins completely to test for proper fit. Then back the pins out of the front until they're only partly inserted into the holes in the back. Apply glue in the back holes and on the part of the pins sticking out of the front. Push the pins completely into position. Use pliers to rotate the pins so their notches face the top of the carrier.

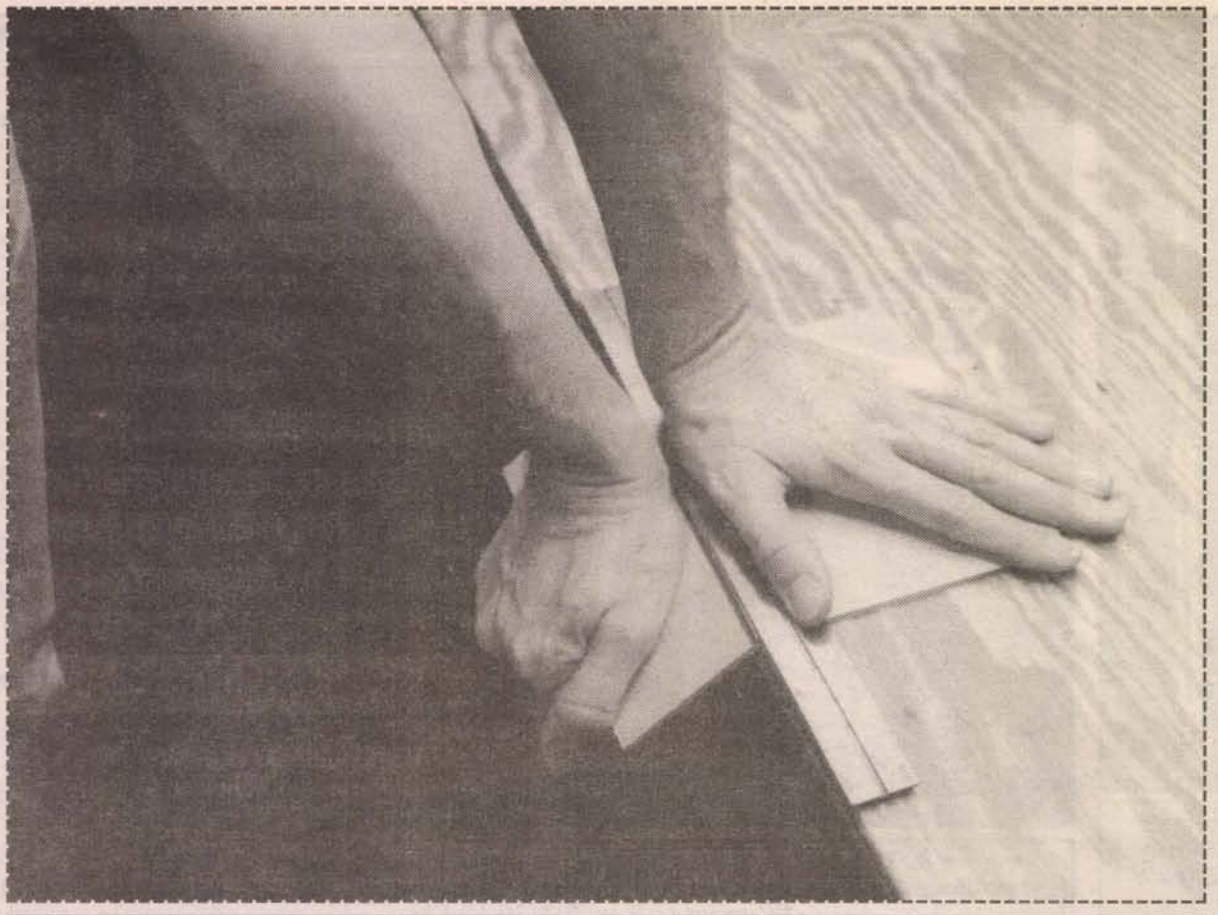


Figure 6. Hold the Plexiglas down with one hand and a straight edge. Use the other hand to press down quickly and firmly on the piece to be broken. The material should break easily.

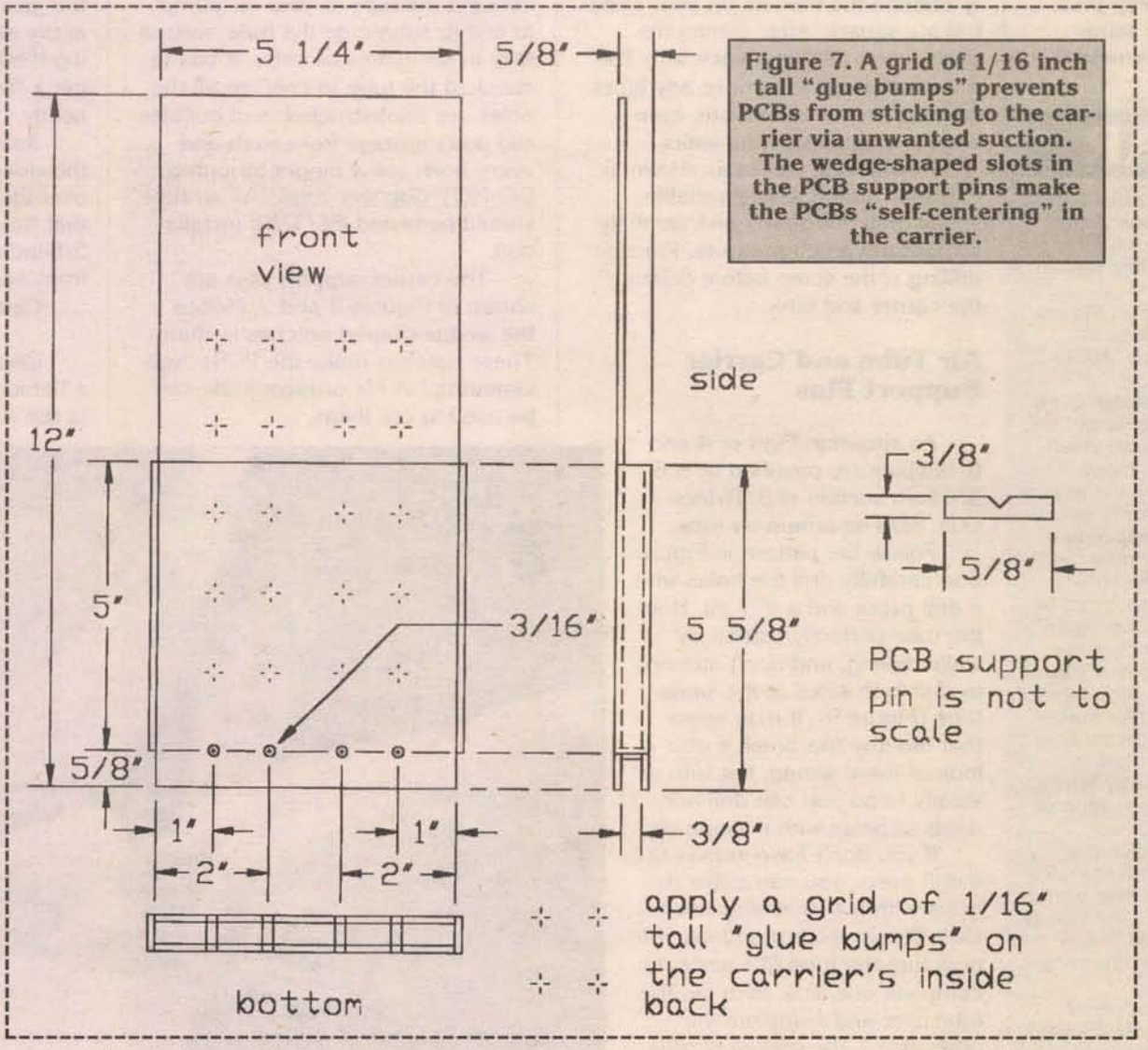


Figure 7. A grid of 1/16 inch tall "glue bumps" prevents PCBs from sticking to the carrier via unwanted suction. The wedge-shaped slots in the PCB support pins make the PCBs "self-centering" in the carrier.

Tank Assembly

Note Figures 4 and 8, which show that the sides of the tank form a cap over the front and back. The bottom, in turn, is a cap over the sides, front, and back. When assembling the tank, apply glue to BOTH surfaces, and remember that the glue also acts as a sealant.

Tank assembly is as follows:

Glue the tiny 1/4- by 3/4-inch blocks to the bottom piece. Set the bottom piece aside. Rest one of the side pieces on a flat surface. Apply a bead of glue on the side and front piece where they'll join. Position the front piece on the side and hold it perpendicular until the glue partially sets. Repeat this process with the back. Apply glue to the remaining side, front, and back where they'll join, then attach the remaining side.

While the glue joints are still flexible, apply glue to the bottom piece, sides, front, and back where they'll join. Attach the bottom piece and (with the tank resting on its bottom) make sure the tank is assembled squarely. When the glue has set, attach the support arms to the sides of the tank (Figures 4 and 8).

Finally, glue foam pads to the support arms. No position is given since they'll line up with whatever warm-water container you have available. These pads dampen vibration and keep the arms from slipping (foam rubber earplugs, split in half, are ideal for this).

Let the tank dry before installing the air tube. Orient the tank as shown in Figure 4. Insert the plugged end of the tube into the hole on the tank's right side until it touches, but doesn't pass through, the hole on the tank's left side. Apply glue around the tube where it meets the tank's outer right side and in the hole on the tank's left side. Push the tube into the hole in the tank's left side and use glue to caulk where the tube meets the tank's sides. Last of all, rotate the tube so the bubble holes face the front and back of the tank.

Checkout and Use

Allow the tank to dry overnight before using. Checkout is straight forward. Make sure your tank and carrier match the drawings, place the carrier in the tank to check for proper fit, then check the tank for leaks. Individual leaks may be sealed with glue. However, if your tank has multiple leaks, you may find it easier to tilt the tank and carefully pour a stream glue down the vertical inside corners. The tilted sides form a trough which channels the glue neatly down the inside edge where it's needed. You can also guide the flow of glue when it reaches the bottom to seal those edges. Let the glue set before sealing another corner.

To use your "super" etching tank, fill it with etchant up to the level of the top of the front of the carrier or to the top of your PCB (whichever is highest). Turn on your air pump. Place the etching tank in a five-gallon bucket (or whatever container you have available). Fill the container to one inch below its top with 125 degree (Fahrenheit) water. This should keep your inner tank near an efficient etching temperature for one to two hours.

If you plan to use the tank for longer than that, you should change the water when it drops below 110 degrees. If you prefer, you can install a heater in your container. If you're mixing a new batch of ammonium persulphate, use 120 degree water, so you won't have to wait for the outer tank's water to heat the inner tank's etchant. (It takes only two cups for a five-inch tall PCB!) Otherwise, wait 15 minutes for the water to warm the etchant in the inner tank. Your "super" etching

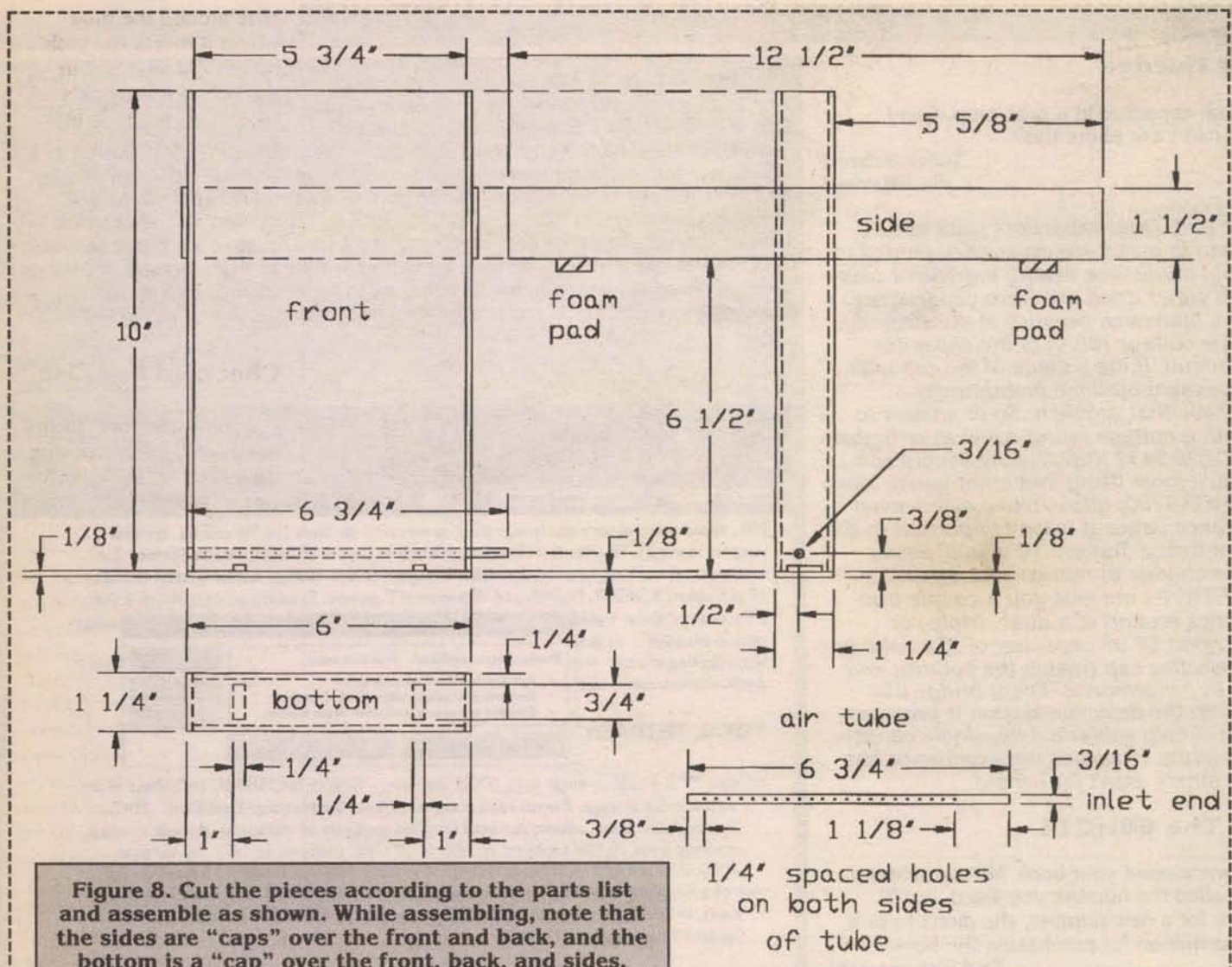


Figure 8. Cut the pieces according to the parts list and assemble as shown. While assembling, note that the sides are "caps" over the front and back, and the bottom is a "cap" over the front, back, and sides.

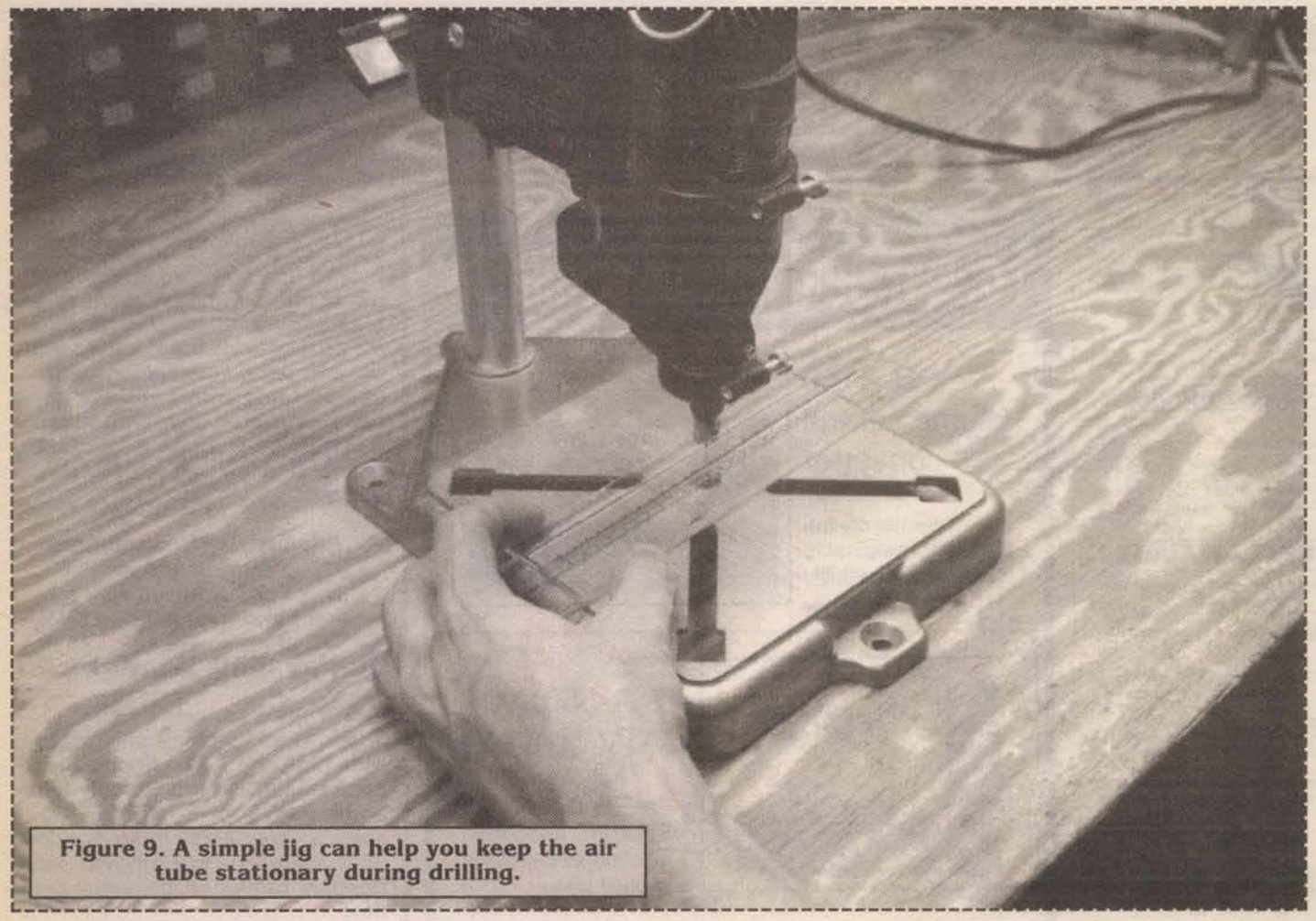


Figure 9. A simple jig can help you keep the air tube stationary during drilling.

tank is now ready to save you time and money.

Variations

You can custom-design the carrier and tank to fit your needs, and if you etch a lot of small PCBs, you can make a tank that REALLY conserves etchant.

My personal favorite is the tank I use to etch two 2- by 4-inch PCBs at the same time. It uses only one cup of etchant!

While you're experimenting, remember that the fit of the carrier, the tank, and air tube are very interrelated. **NV**

PARTS LIST

ETCHING TANK AND CARRIER
(all parts are 1/8-inch thick Plexiglas unless otherwise specified)

CARRIER
2—(sides) 5 by 5/8 inches
1—(back) 12 by 5-1/4 inches
1—(front) 5-5/8 by 5-1/4 inches
4—(PCB support pins) 3/16 inch (O.D.) hard aquarium air tube, 5/8 inch long (notched to align PCBs in carrier)

TANK
2—(front and back) 10 by 5-3/4 inches
2—(sides) 10 by 1-1/4 inches
1—(bottom) 6 by 1-1/4 inches
2—(tank supporting arms) 12-1/2 by 1-1/2 inches
2—(carrier support blocks) 3/4 by 1/4 inch
1—(bubble tube) 3/16 inch (O.D.) hard aquarium air tube, 6 3/4 inch long (drilled or pierced for air holes)

Miscellaneous 1—aquarium air pump 1—3/16 inch flexible aquarium air hose

SOURCES

* Plexiglas is available from hardware stores and businesses that specialize in acrylic plastic sheeting. In fact, some businesses that specialize in selling acrylic plastic also sell long strips of 1/8 inch thick scrap sheeting, 4 inches to 7 inches wide for as little as $1.00 per pound. These strips are ideal for building your etching tank.
* Plastics specialty stores are the only place you're likely to find Weld-On #16 acrylic adhesive.
* Acrylic plastic scoring tools are available in hardware and building supply stores.
* Hard, 3/16 inch O.D. aquarium air tubes and flexible 3/16 inch air tubing are available from stores that specialize in aquariums and tropical fish.
* Ammonium Persulphate is available from **Mouser Electronics**, 958 North Main Street, Mansfield, TX 76063 **(800) 346-6873**.

The etching tank and carrier are available as a complete kit (professionally cut and completely pre-drilled, everything but the glue and the air pump) from: **Futuretech**, P.O. Box 6291, Gulf Breeze, FL 32561. The price is $34.95 (plus $5.00 shipping and handling) FL residents add 7% sales tax.

Dual Electrolytic Capacitor Needed

Q. I cannot find a replacement for a dual capacitor in a tube amp. Can I replace it with two discrete caps? Who can I ask about this?

Tater Schuld
via Internet

A. *You can ask me. Been there, done that. Dual capacitors used to be quite popular because they were cheap to make. However, they tended to fail a lot because they were so cheaply made. The deadly ingredient was a very caustic electrolyte paste which either dried out (zero capacitance) or leaked all over the place (the Blob). Moreover, because of the electrolytic paste, it was very important that the voltage rating of the capacitor matched the working voltage of the circuit. If the voltage of the cap was higher than the operating voltage, the cap would fail prematurely. Thankfully, today's capacitors don't have that problem. So in answer to your question, use two capacitors with a voltage rating equal to or higher than the original. All Electronics (800-826-5432 http://www.allcorp.com) usually has a couple in stock, but you'll more likely find what you're looking for from Allied Electronics (1-800-433-5700; http://www.allied.avnet .com). Don't worry about the capacitance value. It wasn't important in the days of old, and it isn't that important today. Today's 10 uF will easily substitute for an old 20 MFD (note the change in nomenclature), and a 100 uF will replace a dead 80 MFD. BTW, let me give you a couple trouble-shooting tips on finding the defective section of a dual-, triple-, or quadruple-section capacitor. Using a good 50 uF capacitor of 250 volts or more, short it across the suspected defective cap (watch the polarity and your fingers!) and notice the change in performance. Every bridge will change something, but when you hit on the defective section it becomes immediately apparent. Often you can simply solder a new, single capacitor in place to fix the problem – for a while. However, my experience has been that when one section fails, the others aren't far behind.*

Microprocessor Design For The 68HC11

Q. In the Feb. '98 Q & A column, you mentioned your book *Microprocessor Design Made Easy* for the 68HC11. I called the number you listed, but it doesn't work. When I asked the operator for a new number, she didn't have a clue. Could you please send me the information for purchasing the book?

Ted Baranowski
Erie, PA

Q. I'm interested in purchasing the book you mentioned in the Feb. '98 column. I dialed the number you printed and all I got was a message that this number is not in service. I've also tried two local bookstores, but have had no luck. How can I get this book?

Kerry Boura
via Internet

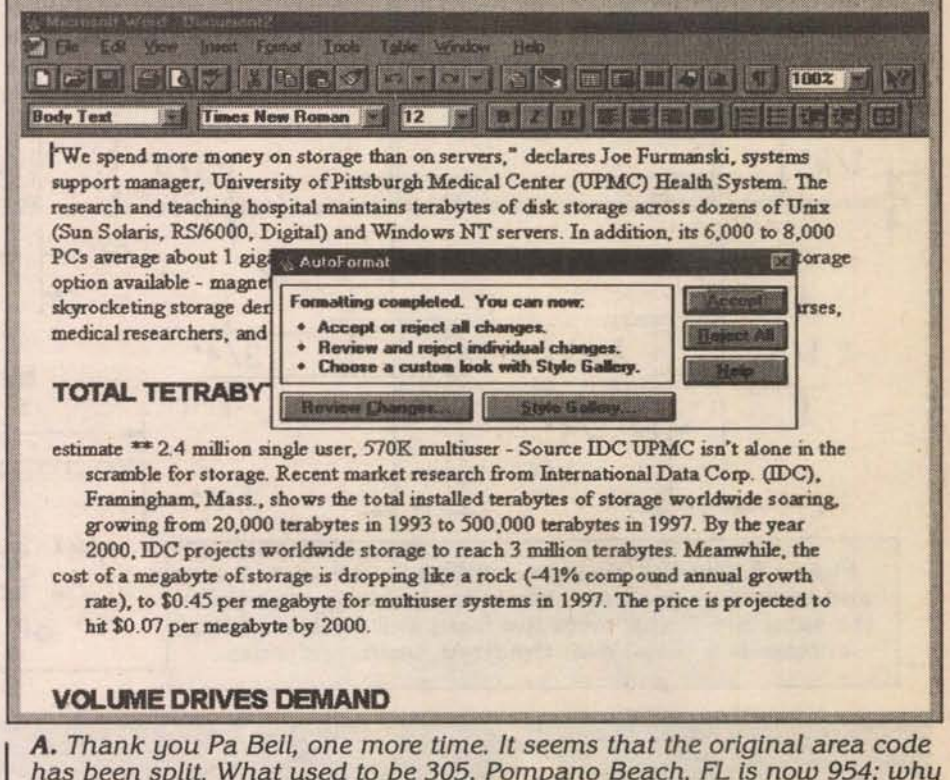
A. *Thank you Pa Bell, one more time. It seems that the original area code has been split. What used to be 305, Pompano Beach, FL is now 954; why the operator didn't catch it, I can't answer (the change happened only two months ago). So the new phone number is 954-784-0900. The same as before, but with a different area code. Oh yeah, the price of the book has increased, too, to $55.00, but that includes all the software. If you're really serious about ordering, I'd use their 1-800-972-3733 number (at least that area code won't change). BTW, I'm only a contributor to this book, even though I wrote more than half the text, and make no royalties off of its sale. It's part of a training course that the company sells (along with optional hardware) and the book has hands-on experiments that will get you through a lot of the 68HC11's kinks. Here's their address.*

Advanced Microcomputer Systems, Inc.
1460 S.W. 3rd St.
Pompano Beach, FL 33069

Reader's Tip

You recently responded to a reader's request for converting HTML screens into text files. Here's another way you can do it using Word for Windows (WinWord versions 6.0 and Word 95). Using the Clipboard, copy and paste the HTML text into an open WinWord document. Click on Format, AutoFormat, and OK. You will now be prompted to review the formatting changes and either accept or reject them. (Hint: the Options button lets you select which format changes to make and which to keep.) Finally, save the document in TXT format (personally, I just keep them in WinWord DOC format). PC World recently listed similar routines for other word processors; check it out at http://www.pcworld.com/software/word_processing/articles/feb98/1602p296.html

Frank Wildeboor
via Internet



Floppy Fails Windows 95

Q. I've got a pet peeve with Windows 95. Explorer only works with 1.2M and 1.44M floppies and applications allow me to only open and save to floppies of these two sizes. Is there a way to set Windows 95 to read/write to 720K and 360K floppies, as well as the higher densities?

John McMichael
via Internet

A. *Well, I have no problems with 5 1/4-inch 360K or 3.5-inch 720K diskettes and Windows 95 Explorer. My guess is that the*

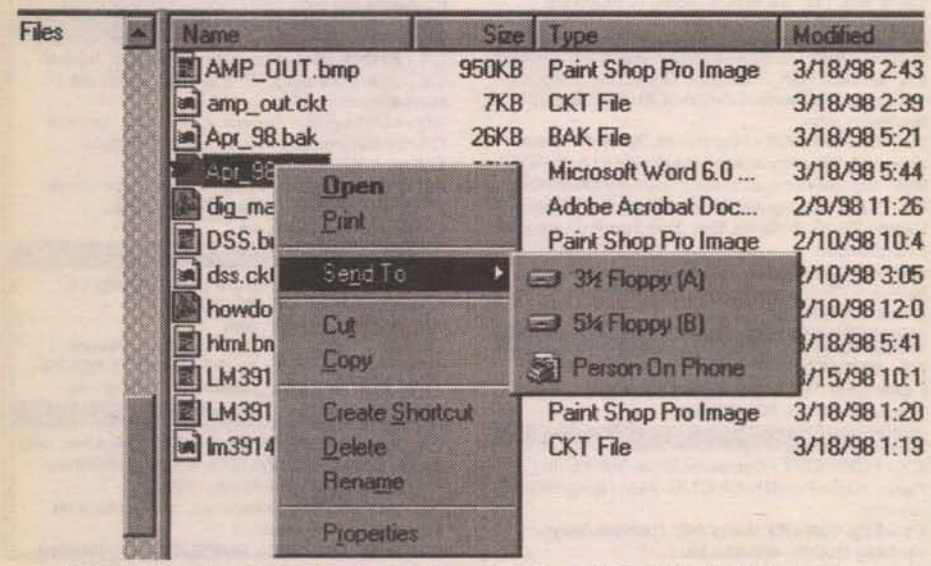
diskettes aren't properly formatted. For whatever reason, Windows 95 forces you to go to the MS-DOS prompt for this chore (often a low-density diskette that's been formatted from the Windows 95 prompt doesn't work properly). Click on Start, Programs, and MS-DOS Prompt. You'll now see a black screen. Type

FORMAT A:/F:720

This tells the A: drive that there's a 720K diskette in the drive, not the typical 1.44 MB. If your B: drive is a 5 1/4-inch, as most are, then the command is

FORMAT B:/F:360

which says to format the diskette in the B: drive with 360K. Well, you're starting to get the idea. You can identify a 1.44 MB diskette by the two holes punched at the top of the disk; a 720K has only one hole. Unfortunately, you have to look at the label of a 5 1/4-inch disk to know the difference between 360K and 1.2 MB; a 1.2 MB will have the word HDD, MD-2, or something similar on the label. When you're done with the formatting, type EXIT. Now bring up the Explorer and – using the right mouse button – do a Copy To command, as shown below. I expect you'll have no more problems.



BTW, if you're trying to format an Apple or Macintosh diskette for use with an IBM compatible, you may have to take the extra step of first reading a properly-formatted IBM diskette, ejecting it, and replacing it with the now-to-be-formatted Apple diskette before issuing the FORMAT command (this isn't always necessary, but it's worth mentioning).

Video Gamers Need Speed

Q. I read one of your reviews on video cards and thought maybe you could help me. I'm in the process of purchasing a Dell Dimension 300 MHz PII and they offer a choice of two video cards. One is the STB Velocity using the nVidia Riva 128 chipset and the other is the Diamond Fire GL 1000 Pro with 8 MB. I've asked Dell and they just give me the specs and won't comment on which is best for gaming. I have a nine-year-old son and our single largest use of the computer is for games so this is very important to us. If you are familiar with either or both of these chips, I would appreciate your insight and recommendation.

Ken Wollman
via Internet

A. *I'm glad that you're looking at the video engines (chips) and not the board's bells and whistles for making up your mind. I've tested video cards with both chips and found the nVidia Riva chip to be slighter faster than the S3 chip that's embedded in the Diamond Fire GL 1000 Pro. When it comes to gaming, though, the question isn't speed, but whether the games you play support one chip or the other. Each chip requires a different driver and not all games support both. So my suggestion is to check out the games you want to play and see which games support which chip, then chose between the two – you might be surprised. Good luck and stomp a Mech Warrior for me!*

Mailbag

Dear TJ:

I was fascinated by your statement that 90% of the electron flow was in the outer 10% of a wire. I also found Arlen Raasch's formula about the region of void interesting, but I think that he is comparing apples to oranges. I believe that determining the amount of void is entirely different from determining the amount of current flow in a section of a wire. Do you stick by your statement?

Robert Olson
via Internet

Response:

Well, I didn't pull this number out of thin air. It actually comes from the "Standard Handbook For Electrical Engineers." However, the size of the wires they deal with are often times an inch or so in diameter, so I think Mr. Raasch has an argument for 24-gauge wire. My original point, though, was why pay premium bucks for gold-plated monster cables when there's no noticeable difference in the sound for normal use – and I stick by that statement. Now I'm sure Mick Jagger uses monster cables for his mile-high stage speakers, as well he should.

Dear Mr. Byers:

Thanks for publishing the JPL stepper motor controller circuit for Jack Shubert. It halved the number of flip flops in my design. I've started implementing it, and discovered two problems with the circuit. The clock input appears to be tied to the reset circuitry, and the TIP120s seem to be wired in the wrong way. I've done the timing by hand with the clock tied to the CP, and the circuit does what's expected of it.

Bruno Malisheski
via Internet

Response:

Yes, the transistors are reversed (see correction in the Mar. '98 column – mea culpa!) and the clock obviously drives the CP inputs. BTW, this design has drawn a lot of good response, and many readers have the circuit up and running with raves about its simplicity.

Events CALENDAR

Continued from page 95

Southwest OH Chapter, 1117 Big Hill Rd., Kettering, OH 45429-1201

MAY 15-16-17

OH - DAYTON - HamVention. Dick Miller N8CBJ, 937-276-6930. E-Mail: chair@hamvention.org Web: http://www.hamvention.org/

MAY 16

CA - FRESNO - Computer Show. Fresno Fgrds. MarketPro 415-456-6730 Web: http://marketpro.com
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
MA - WESTPORT - Computer Show. White's Convention Center. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net
MN - WILLMAR - Hamfest & Electronics Swapmeet. 9am-2pm. Steve Gardner WB0MAO, 320-235-1560. E-Mail: W0SW@AMSAT.ORG
TX - HONDO - Medina Co. ARC Hamfest. Ray Martinez N5VRE, 830-931-3307. E-Mail: n5vre@stic.net

MAY 16-17

GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827

MAY 17

CA - STOCKTON - Computer Show. San Joaquin Co. Fgrds. MarketPro 415-456-6730. Web: http://marketpro.com
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776. Web: http://web.mit.edu/wlmx/www/swapfest.html
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NH - PORTSMOUTH - Computer Show. Yoken's. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net

MAY 22-23

MS - PASCAGOULA - Hamfest. Jackson County Fairgrounds. Fri. 5pm-9pm, Sat. 8am-3pm. Charles Kimmerly N5XGI, 228-826-5811

MAY 23

CA - YUBA CITY - Computer Show. Yuba-Sutter Fgrds. MarketPro 415-456-6730. Web: http://marketpro.com
CT - VERNON - Natchaug ARC Hamfest. Wayne Rychling N1GUS, 860-487-1921. E-Mail: warych@neca.com

MAY 23-24

WY - RAWLINS - Carbon County ARS Hamfest. Ken Fults KC7RZI, 307-324-6067

MAY 24

CA - SAN DIEGO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730. Web: http://marketpro.com
CA - SANTA ROSA - Computer Show. Sonoma Co. Fgrds. MarketPro 415-456-6730. Web: http://marketpro.com
IL - CHICAGO - ARC Hamfest. 8am-3pm. DeVry Institute of Technology, 3300 N. Campbell. George Sopocko WA9JEZ, 773-545-3622
MD - WEST FRIENDSHIP - Hamfest. Howard Co. Fairgrounds. 8am-2:30pm. 301-879-2785. E-Mail: FSARC@aol.com

MAY 25

CA - MODESTO - Computer Show. Centre Plaza at Double Tree. MarketPro 415-456-6730. Web: http://marketpro.com

MAY 29-30

NE - SOUTH SIOUX CITY - Midwest/Dakota Div. Convention. Mike Nickolaus NF0N, 402-494-6070. E-Mail: nf0n@avalon.net
Web: http://www.pionet.net/~k0brd/hamboree/

MAY 29-30-31

NY - ROCHESTER - Atlantic Division Convention. Harold Smith K2HC. 716-424-7184. E-Mail: rochfst@frontiernet.net Web: http://www.rochesterhamfest.org

MAY 30

CA - STOCKTON - Computer Show. San Joaquin Co. Fgrds. MarketPro 415-456-6730. Web: http://marketpro.com
CO - LOVELAND - Superfest Swatmeet. Larimer County Fairgrounds, 700 S. Railroad. Michael Robinson N7MR, 970-282-1167
ME - PORTLAND - Computer Show. Expo Center. Northern Computer Shows 978-744-8440. E-Mail: tchc@iamerica.net

MAY 30-31

CA - VENTURA - Computer Show. Ventura Co. Fgrds. MarketPro 415-456-6730.
Web: http://marketpro.com
OR - SEASIDE - SEAPAC Ham Conv. Seaside Convention Center. Randy Stimson KZ7T, 503-297-1175. Web: http://www.easystreet.com/~otvarc

MAY 31

CA - SACRAMENTO - North Hills RC Hamfest. Bob Naylor AC6HF, 916-966-3654. E-Mail: ac6hf@juno.com Web: http://www.ns.net/~NHRC
CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
CANADA - QUEBEC - SOREL-TRACY - Hamfest. Jean A. Gadoury VE2UL.
E-Mail: jgadoury@sorel-tracy.qc.ca
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

JUNE 1998

JUNE 5-6-7

TX - ARLINGTON - West Gulf Division Convention. Tom Gentry K5VOU, 972-442-1721

JUNE 6

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CANADA - QUEBEC - MONTREAL - ARC Hamfest. James Hay VE2VE, 514-697-7205.
E-Mail: jrhay@haya.qc.ca
ME - HERMON - Pine State ARC Hamfest. Roger Dole KA1TKS, 207-848-3846
MI - GRAND RAPIDS - Annual Hamfestival. Hudson-ville Fairgrounds, off I-96 x-way. Randy N8KQX, 616-532-5450
TN - NASHVILLE - ARC Hamfest. TN State Fairgrounds. 8am-5pm. Bob Malone WB5ZDS, 615-865-6225

JUNE 6-7

CA - SACRAMENTO - Computer Show. Cal Expo. MarketPro 415-456-6730 Web: http://marketpro.com
WA - DRYDEN - Apple City ARC Hamfest. Greg Johnson WA7TSP, 509-663-1081.
E-Mail: g.c.johnson@mail.sprint.com

JUNE 7

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
CA - SAN DIEGO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730.
Web: http://marketpro.com
CT - NEWINGTON - AR League Hamfest. Ralph Borriello N1VIM, 860-828-1695
IL - PRINCETON - Starved Rock RC Hamfest. Debbie Burton N9DRU, 815-795-2201.
E-Mail: dbkatz@mtco.com
Web: http://www.prairienet.org/srrc/
IN - WABASH - County ARC Hamfest. Don Spangler W9HNO, 219-563-8487. Web: http://www.netusal.net/~qrziota/
NY - QUEENS - Hamfest. NY Hall of Science Parking Lot, Flushing Meadow Corona Park, 47-01 111th St. Stephen Greenbaum WB2KDG, 718-898-5599 night only. E-Mail: WB2KDG@bigfoot.com

Events CALENDAR

OH - MEDINA - Two Meter Group Hamfest. Mike Rubaszewski N8TZY, 330-273-1519
PA - BUTLER - Hamfest. Butler Farm Show Grounds. 8am-4pm. George Artnak N3FXW, 412-854-5593. Web: http://www.users.sgi.net/~wolfie/
VA - MANASSAS - Ole Virginia Hams ARC Hamfest. Mary Lu Blasdell KB4EFP, 703-369-2877
WI - JUNCTION CITY - Swapfest & Auction. US Army Reserve Ctr. John Feltz W9JN, 715-457-2506. E-Mail: jfw9jn@tznet.com

JUNE 12-13

GA - ALBANY - ARC Hamfest. Arthur Shipley N4GPJ, 912-439-7055

JUNE 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CANADA - ONTARIO - FERGUS - Guelph & Kitchener-Waterloo ARCs Hamfest. Bill Smith VE3WHS, 519-821-6642. E-Mail: smith.ve3whs@sympatico.ca Web: http://www.kwarc.org/fleamarket
KY - PADUCAH - ARA Hamfest. Executive Inn Convention Ctr. 8am-3pm. Craig Martindale WA4WBU, 502-444-6822
NY - CORTLAND - Skyline ARC Hamfest. Andrew Slaugh KB2LUV, 607-753-0597. E-Mail: sany@sanyips.com

JUNE 13-14

GA - DALTON - Computer show. North GA Fairgrounds. Georgia Mountain Productions 706-838-4827

JUNE 14

IL - WHEATON - Six Meter Club of Chicago Hamfest. DuPage County Fairgrounds, 2015 Manchester Rd. Joseph Gutwein WA9RIJ, 630-963-4922
KY - ERLANGER - Ham-O-Rama '98. Lions Park. 8am-3pm. Robert Blocher N8JMV, 513-797-7252 eves. E-Mail: krood@tso.cin.ix.net
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NY - BETHPAGE - Long Island Mobile ARC Hamfest. Richie Selzer N2WJL, 516-520-9311. E-Mail: n2wjl@juno.com
TN - KNOXVILLE - RAC of Knoxville Hamfest. David Bower K4PZT, 423-974-5064. E-Mail: d.bower@ieee.org Web: http://www.kornet.org/rack

JUNE 19-20-21

GA - ATLANTA - Hamfestival '98. Greg Barrett N5BDJ, 770-649-1467. E-Mail: gbjb@mindspring.com Web: http://www.saf.com/arc

JUNE 20

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
NJ - DUNELLEN - Raritan Valley RC Hamfest. Doug Benner WB2NJH, 908-469-9009. E-Mail: wb2njh@aol.com
WV - BLUEFIELD - East River ARC Hamfest. Don Williams WA4K, 540-326-3338. E-Mail: WA4K@AMSAT.ORG

JUNE 20-21

GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827

JUNE 21

IN - CROWN POINT - Lake Co. ARC Hamfest. Lake Co. Fairgrounds. Malcolm Lunsford W9MAL, 219-769-3925. E-Mail: w9mal@cris.com
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776. Web: http://web.mit.edu/wlmx/www/swapfest.html
MD - FREDERICK - ARC Hamfest. Eric Gammeter N8AAY, 301-865-0865
MI - MONROE - Monroe Co. Radio Comm. Assn Hamfest. Fred VanDaele KA8EBI, 313-242-9487
OH - MACEDONIA - Cuyahoga ARS Hamfest. Rich James N8FIL, 1-800-404-2282. http://www.cars.org

JUNE 27

FL - FT. MCCOY - ARC Hamfest. Tom Bench KT4VF, 352-546-3967. E-Mail: w4frc@qsl.net Web: http://www.qsl.net/w4frc

JUNE 28

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

JULY 1998

JULY 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

JULY 5

PA - WILKES-BARRE - Murgas ARC Hamfest. Robert J. Michael WB3FAA, 717-288-3532

JULY 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
IN - INDIANAPOLIS - Central Division Convention. Rick Ogan N9LRR, 317-251-4407
MO - KANSAS CITY - PHD ARA Hamfest. Bob Roske WA0CLR, 816-436-0069. E-Mail: wa0clr@juno.com Web: http://www.tfs.net/~caltman/phdara/phdara.htm
NC - SALISBURY - NC Alligator Group Hamfest. Walter Bastow N4KVF, 704-279-3391. E-Mail: alligatorl@juno.com
OK - ALTUS - Altus Area ARA Hamfest. Ronald Hughes KB5UVC, 580-482-7994
WA - KENNEWICK - Tri Cities ARC Hamfest. Dick N7WLD, 509-783-3479. E-Mail: dick_goranson@kcc-computers.com

JULY 12

IL - PEOTONE - Kankakee ARS Hamfest. Don Kerouac K9NR, 815-939-7548. E-Mail: K9nr@juno.com Web: http://www.geocities.com/CapeCanaveral/Hangar/5711/
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NJ - AUGUSTA - Sussex Co. ARC Hamfest. Dan Carter N2ERH, 973-948-6999. E-Mail: scarcnj@qsl.net Web: http://www.qsl.net/scarcnj/
NY - ALEXANDER - Genesee Radio Amateurs Hamfest. David Carlson KA2OQZ, 716-786-3622. E-Mail: carlson@frontiernet.net Web: http://www.frontiernet.net/~wittman/wittman/GRAM
PA - KIMBERTON - Mid-Atlantic ARC Hamfest. Bob Haase W3SA, 610-293-1919

JULY 17-18-19

MT - EAST GLACIER - MT State Convention. Gerry Leach VE6BVZ, 403-285-5547. E-Mail: leachg@cadvision.com

JULY 18

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
TX - TEXAS CITY - Tidelands ARS Hamfest. Carl W. Steele Jr. WA5WVP, 409-948-0308

JULY 19

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776 Web: http://web.mit.edu/w1mx/www/swapfest.html
MO - WASHINGTON - Zero Beaters ARC Hamfest. Keith Wilson K0ZH, 314-629-2264
NY - FARMINGVILLE - Radio Central ARC Hamfest. Jo Ann Colletti N2IME, 516-399-1877. Web: http://www.li.net/~n2mdq
OH - VAN WERT - Hamfest. County Fairgrounds, US 127 S. Louie Thomas WD8LLO, 419-238-2812. E-Mail: barnesrl@bright.net Web: http://www.bright.net/~barnesrl/w8fy.htm

JULY 24-25

FL - MILTON - Milton ARC Hamfest. Mark McAnally KE4QKN, 850-626-7686. E-Mail: KE4QKN@AOL.COM
OK - OKLAHOMA CITY - OK State Convention. Harold Miller KB1ZQ, 405-672-7735. E-Mail: n11pn@swbell.net

JULY 24-25-26

AZ - FLAGSTAFF - AZ State Convention. Mark Kesauer N7KKQ, 602-440-2039

JULY 25

NC - WAYNESVILLE - Western Carolina ARS Hamfest. Thomas Queen K4BNP, 704-258-2639
OH - CINCINNATI - OH-KY-IN ARS Hamfest. Dana Laurie WA8M, 513-761-7388

JULY 26

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

AUGUST 1998

AUGUST 1

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
KY - BOWLING GREEN - KY Colonels ARC Hamfest. Leon Garrett K4CIT, 502-842-5307
NC - HIGH POINT - ARC Hamfest. Mark McMahan KB4MFP, 910-887-3039
OH - COLUMBUS - Voice of Aladdin ARC Hamfest. Jim Morton KB8KPJ, 614-846-7790

AUGUST 8

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

AUGUST 15

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
GA - ALBANY - Computer & Electronics Expo. Hasan Temple, 1822 Palmyra Rd. 9am-5pm. Sandy Rabb 912-888-9393. E-Mail: GODS@SURFSOUTH.COM

AUGUST 16

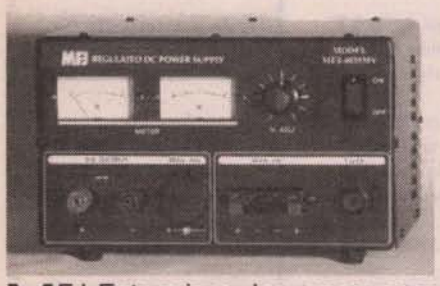
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776 Web: http://web.mit.edu/w1mx/www/swapfest.html
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

AUGUST 23

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

New Product News

MFJ-4035MV DC REGULATED POWER SUPPLY



MFJ Enterprises, Inc. announces the new MFJ-4035MV 35/30 amp adjustable regulated DC power supply — only $149.95.

MFJ's new heavy duty power supply features 35 amps surge and 30 amps continuous, and is adjustable and regulated.

The MFJ-4035MV voltage is front panel adjustable from 1 to 14 VDC with detect set at 13.8 VDC. The power supply has lighted front panel meters and an ON/OFF switch.

Three different OUTPUT terminals include a five-way binding post for HF/VHF radio, two pairs of quick connects for low current accessories, and a cigarette lighter socket for mobile accessories.

It has a front-panel fuse holder for convenient fuse replacement. The voltmeter and ampmeter monitor load continuously. A quiet internal cooling fan generates a tremendous airflow, keeping components cool.

For more information, contact:

MFJ ENTERPRISES, INC.
P.O. BOX 494, DEPT. NV
MISSISSIPPI, MS 39762
601-323-5869 FAX: 601-323-6551
1-800-647-1800
E-MAIL: mfj@mfjenterprises.com
WEB:
http://www.mfjenterprises.com

THE CAPANALYZER 88

Electronic Design Specialists introduces an in-circuit electrolytic capacitor checker that is guaranteed 100% accurate in circuit, with a money back guarantee.

The The CapAnalyzer 88 automatically discharges the cap, measures DCR, checks or shorts, and measures ESR in circuit, all in one step.

Values from 0.47 uF to 2200 uF can be measured with 100% accuracy. Only 2.5 seconds is required for each cap, so that an entire PC board can be checked in just minutes.

All signals are under 50 millivolts with a 5-ohm test impedance to prevent semiconductors, resistors, or coils from causing false readings.

A slider control sets the value of DCR for the alarm beeper to warn the technician. The state-of-the-art design uses a microprocessor and a two-color 20 segment LED meter to read ESR with a resolution down to 0.1 ohm. A beeper allows eyes-off use by beeping from one to five beeps depending on the ESR reading and quality of the capacitor.

Included is a one-handed, gold-plated tweezer probe that can check both conventional and surface-mounted capacitors, and a handy three-color chart on the front panel that shows typical ESR readings for good and bad capacitors in reference to their capacity.

It is battery-operated (AAA batteries) and handheld to make it easier to use, either in the shop or in the field. A three minute warning beeper alerts the technician that the unit is on if no testing is detected.

The CapAnalyzer 88 is available at most electronics distributors, as well as from EDS directly, for $169.00.

For more information, contact:

ELECTRONIC DESIGN SPECIALISTS
4647 APPALACHIAN ST.
DEPT. NV
BOCA RATON, FL 33428
561-487-6103

FIVE NEW ACCESSORY HEADS FOR PMM-1

Amprobe Instrument announces the release of their five new interchangeable accessory heads to expand the capabilities of their pen multimeter, model PMM-1. The accessory heads were designed with the HVAC Technician in mind.

The complete series extends the PMM-1's existing testing capabilities from AC and DC volts and resistance to now measure capacitance (start/run capacitor testing), DC microamps (flame rod and flame sensor testing), relative humidity, carbon monoxide (IAQ testing), and single or differential temperature (compressor efficiency testing).

AC amps to 300A is accomplished with the existing accessory, model PMM-C.

Each new accessory head is designed to output imVDC per unit measured. The unique mechanical design allows each head to slide onto the PMM-1, but may be used with any DMM with a DC millivolt resolution in conjunction with the appropriate test lead, model TL-10S.

For more information, contact:

AMPROBE INSTRUMENT
630 MERRICK RD., P.O. BOX 329
DEPT. NV
LYNBROOK, NY 11563
516-593-5600 FAX: 516-593-5682

THE WIRELESS CONTROLGATE™

Emge Industries, Inc., announces the introduction of a new line of industrial radio remote controller modem systems designed to interface with electrically operated machinery and equipment. These systems are available in either simplex (one-way communication) or duplex (two-way communication) versions. A variety of analog, digital, RS-232, and RS-485 inputs and outputs are available for tailoring the system to the customer requirements.

The ControlGate™ ACE-928 utilizes state-of-the-art frequency hopping spread spectrum radio technology. Operating in the 902 to 928 MHz band, the ControlGate ACE-928 design offers unmatched noise immunity for the most stringent applications where communication reliability is of prime concern.

Electrical equipment or machinery controlled by a 0-5 VDC or 4-20 mA analog signal command can be safely and easily operated by the ControlGate ACE-928.

Eliminated by the ControlGate ACE-928 are the traditional wiring costs associated with long runs of control wiring and conduit to such devices as potentiometers, flowmeters, temperature sensors, pressure sensors, displacement sensors, velocity sensors, machine controllers, PLCs, and PCs.

The ControlGate ACE-928 systems also offer digital contact closures for simple ON-OFF commands. In addition, RS-232 and RS-485 ports are available on some models for easy computer interface. The duplex version offers standard two-way communication and the ability to setup a MODBUS network with master/slave units. Closed loop control is easily facilitated with the ControlGate products. All units are conveniently powered by low-voltage DC.

For more information, contact:

EMGE INDUSTRIES, INC.
1060 WINGFOOT ST., DEPT. NV
PLACENTIA, CA 92870-4444
714-996-5777 FAX: 714-996-5748

Continued from page 15

Connect each thermistor from ground to the five-volt supply through a resistor to limit the current. Select the resistors to keep the thermistor power dissipation at 10 to 80% of their rating over the temperature range.

The op-amps are used as simple comparitors. One connects to the pannel and reservoir thermistors, a second to the reservoir and water heater, and a third to the water heater and a pot to set the shut off point.

Each comparitor can drive a solid-state relay and the corresponding pump.

You should be able to salvage the solid-state relays and thermistors from your present system.

Mike Beaver
Los Altos, CA

ANSWER TO #129713 - DEC. 1997

Your IC-2F and IC-3P by Inoue Communications Equipment were imported and marketed in the USA by Varitronics, Inc., of Phoenix, AZ — long since defunct.

The ICE models FDFM-2 and FDFM-2S preceded the IC-2F. Only after Varitronics' demise did Inoue market under the name Icom in the U.S.

Diodes D11 and D12 are in a circuit similar to the typical VSWR detector. D11 detects "forward" RF power and drives the meter via potentiometer FVR4. D12 detects any "reflected" RF power and drives the automatic protection circuit. Potentiometer FVR6 controls APC threshold adjustment.

Inoue typically used 1N60 germanium diodes in this function in similar equipment and a pair of 1N60's or equivalants such as ECG-110A should function perfectly. The TCG110 is most likely just a 1N60, certainly it is similar.

If you need a manual and adjust-

ANSWERS TO #3981 - MAR. 1998

A simple hardware method to obtain accurate low-frequency square-waves begins with the construction of an astable multivibrator using a TLC555 CMOS timer IC configured to provide an adjustable frequency range of 100 times the desired output frequency range.

The output of the TLC555 timer is then divided by 100 using two stages of CMOS 4017 divide-by-10 ICs.

All ICs and components needed can be inexpensively obtained at Radio Shack. The IC pin-outs and data can be found in *Radio Shack's Semiconductor Reference Guide.*

John McMichael
Laramie, WY

ANSWERS TO #3981 - MAR. 1998

A good answer to this question can be found on page 37 of the same issue the question was in March '98, in TJ Byer's "Electronics Q & A" column. I recommend the TLC555 circuit.

Dick Moore
via Internet

ment information, contact me directly.

Robert G. Wheaton W5XW
San Antonio, TX

ANSWER TO #2987 - FEB. 1998

The Intech VDAC 1842N is a video DAC with binary input, .015 microsecond settle time, TTL logic, CMOS logic, and latches.

According to the *IC Master DataBook* (1994 edition), the 1842N is made by Advanced Analog (a division of Intech).

You probably can get a data sheet from a sales representative in your area. The following is all the information on sales representatives in your area. Also listed are three phone numbers and the company address of Advanced Analog, since I am not sure which is closest to you.

LaJolla KSA 619-453-5720; Manhattan Beach Pacific Edge 213-372-5435; and Sunnyvale Pass Assoc. 408-735-9040.

Company address:

Advanced Analog (Division of Intech)
2270 Martin Ave.
Santa Clara, CA 95050
408-988-4930

Dennis Gifford
Henagar, AL

ANSWER TO #2984 - FEB. 1998

I assumed you didn't want a tour of the factory, but some practical information on how to replace a defective bipolar cap during a repair job or how to make an odd-ball size for that weekend project.

This circuit will do the job just fine. There are a few important design considerations.

A. These capacitors are NOT in series for calculation purposes.

The total capacitance in the diagram is <u>not</u>

$$\frac{1}{C_{total}} = \frac{1}{10\ uF} + \frac{1}{10\ uF} = 5\ uF$$

It's just 10 uF.

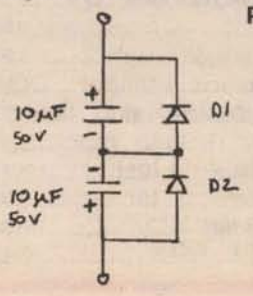
Also the total voltage capacity is not 100 volts. It's just 50 volts. These capacitors are not in series. The diodes simply put one capacitor into the circuit and then the other.

B. The diodes and the capacitors might have to carry some surprisingly high currents. Good examples are the power stage of an amplifier or the vertical deflection circuit of a television. Be sure to check the "ripple current rating" and "core temperature" for the capacitors and the "forward current rating" and PIV for the diodes.

If the old capacitor burned out, consider designing 20%-50% more current carrying capacity into the replacement.

C. Pay attention to safe design practices. If a diode "opens" due to high current or a bad solder joint, the associated capacitor can explode (just like any other reversed-biased electrolytic).

Robert V. Miller
Trenton, NJ



ANSWER TO #1987 - JAN. 1998

Your problem is simple to build, thanks to a fairly new product from National Semiconductor.

The LM34CZ-ND is a precision temperature sensor that is packaged in a TO-92 case. The range is -40 to 230 degrees F. The device has a wide power supply range (3-15 VDC, I think) and the current drain is very low.

With the sensor that I made, I soldered three 24 ga. wires with shrink sleeving, added a little silicone adhesive, and shrank another piece over the whole thing exposing only the case of the device. This enables the sensor to be immersed.

The three connections are ±V and output voltage which corresponds to the temperature, i.e., 220-230 deg. = 2.200-2.300 VDC. The device is available from **Digi-Key 1-800-344-4539**.

Craig Dodds
Pensacola, FL

ANSWERS TO #3985 - MAR. 1998

1. It is hard to give you an accurate answer to how you can learn the Morse Code better. You gave no indication of the process you are using now. Nor did you indicate the speed you are presently able to copy and your goal speed. As a person who regularly teaches Morse Code, I offer you these suggestions.

To learn code, first you must know each letter, number, and character or symbol required. Learning them is best with a computer to generate code. This is very easy to do as software is abundant and audio cards are cheap.

Determine your goal speed. Take that goal speed and use that as the actual speed for learning your code and each character. The trick is to use a method known as Farnsworth Spacing. This method sends the character at a higher speed and spaces the characters out, for a resulting "lower" speed of transmission. What you are trying to do here is recognize the "sound" or "rhythm" of each character at the higher speed, and as you progress, reduce the timing between characters to build your speed.

This is the most effective way to learn Morse Code, proven over many years. There are other methods people attempt to use, which "may" help you learn code, but my experience has been that these other processes create much confusion.

The International Morse Code is the "real" Morse Code used today. The other common code used in "telegraph" days was the American Morse Code. This was a code better-suited for the "click" of the telegraph systems. Don't spend time learning this for code tests. It is not the same, though similar.

Mark Hanz
Houston, TX

2. The best way to learn Morse code is to practice for 15 minutes a day. Practice with a friend if you can, and don't skip any days! You'll attain five-words-per-minute in about a month, qualifying for a Novice class amateur radio license. In about two more months, you'll attain 13-words-per-minute and qualify for the General license.

There are no short cuts, but be sure to think of each letter as a SOUND made up of dits and dahs. Never think of dots and dashes, and don't think of the printed representation of the dits and dahs. That only adds a useless extra step.

A dit followed by another dit or dah should be pronounced di (dih), not dit. For example, B is DAH-di-di-dit.

International Morse Code is the "real" Morse Code, being used almost exclusively today. It's the Morse Code you need to learn for your amateur radio license.

The "other" Morse Code is called the Continental Morse Code. It was widely used long ago in wire circuits, but is almost never used in radio.

Practice every day and don't get discouraged! I qualified for the General class license when I was 14, and it was a lot of fun.

John J. Herro
Palm Bay, FL

3. I assume you are practicing on a regular basis, but that you've reached a plateau. This is common. The only way through the plateau is to press onward and keep practicing. You might speed the process by changing your mind set. Spend some time learningwhat common words and letter groups sound like. Just as "CQ" probably has a sound all its own to you by now, so willwords like "the," "QTH," "name," and "rig" some day.

If you keep that in the back of your mind while you're using the code, you might get there sooner. Get on the air, after a few weeks of operating, your speed will pick up on its own. If you're using a straight key, think about moving to a keyer. Your transmit speed will pick up faster than your receive speed and that will encourage your contacts to transmit faster to you. This will push you to keep up.

If you're not on the air yet, try to find practice tapes that send the characters at a rapid rate, but pause between characters long enough for you to recall the meaning. That way you won't be counting dits and dahs and translating, but will start to hear the pattern of the characters as a complete unit. Di dah dah just sounds like W to me, it is no longer one dit and two dahs. Likewise, dah dididit dit is THE not T H E.

As for your other question, the Morse Code (A.K.A. the American Morse Code) was used in early telegraph systems. Those systems had pens that actually drew the dots and dashes on a paper tape. The operators eventually learned to bypass the paper tape by decoding the sound of the mechanism directly. The International Morse Code (hopefully the code you are studying) is a slight variation on the original and is what is used in radiocommunication.

Tom Tillander
Bay Village, OH

reader FeedBack

Continued from page 6

Nuts & Volts audience includes beginners, as well as seasoned electronics engineers. A beginner is depending on an accurate circuit description of operation to learn from the article whether or not he actually builds the circuit.

I sincerely do not intend to discourage Mr. Blechman. I admire his writing ability, as well as his technical capabilities and I commend him for submitting interesting articles.

John Smith
Plano, TX

Response:

John, you may have a good point regarding the use of the LED as a voltage stabilizer. I did not remove the LED to test the effect, but the unit is quite stable in operation with the LED, and since the telephone company is supplying the power, there's really no reason to remove it. It also acts as a "power-on" indicator.

Thanks for your kind comments about my articles. Twenty-two construction projects, many of which have appeared in past issues of Nuts and Volts, are in my new book, Simple, Low-Cost Electronics Projects from **LLH Technology Publishing** (www.LLH-publishing.com), **1-800-247-6553**.

Fred Blechman
West Hills, CA

After reading "Reader Feedback" about the "3-1/2 Digit Module Primer," I have a comment. Yes, one cannot connect the negative power supply to the negative of the measured voltage, but as long as the inputs are 1.5 volts within the power rails, the meter will work.

John Erskine
Los Angeles, CA

HOW TO PLACE A CLASSIFIED AD

TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY (not all caps)** on a separate piece of paper. Spell out words when submitting hand-written copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for **bold** and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. **Enclose your name, address, phone number, and *Nuts & Volts* account number from your mailing label** (if available) for identification purposes. Include full payment — **CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY** — and mail your completed order to:

NUTS & VOLTS MAGAZINE, 430 Princeland Ct., Corona, CA 91719.

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You may fax in ad copy or changes before the closing date (5:00pm on the **5th**) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

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Prepaid ads received by 5:00pm on the **closing date (5th of the month)** will appear in the following month's issue. Ads postmarked through the **5th**, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 5th. Cancellations and changes must be submitted in writing.

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All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. **NO REFUNDS**. Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your ad copy.

Choose a category for your ad from the classifications listed below.

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95N004 **$4.95 each**

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Good for "T Hunts," Beacon, CW, Rig, Telemetry experiments, etc. This one-Watt transmitter will operate from approx. 100 MHz to 150 MHz. 24 MHz crystal is included (may be tuned to harmonic). Assembled, with documentation. Must be modified to frequency of choice. Runs on 9VDC.

97K003 **Only $24.95 each**

11-PIN SOCKET

98J001 **$1.49**

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BIPOLAR STEPPER ACTUATOR

12VDC @ 0.9A, 100s/rev, 3.6°, with 2" x 0.25" lead screw. NEMA-17 size.

98M001 **$2.49 each**

AC-DC METER

Scale calibrated to 24VDC and 240VAC. 10mA movement. Approximately 1.5 inches square.

98A002 **$2.95**

MS DOS 5.0

3.5" diskettes, with manual.

97C048 **$4.95 each**

V/H COAXIAL SWITCH

RLC Electronics No. 029-394707-004. 28 VDC, four SMA connectors, with pinout sheet.

96B001 **$90.00 each**

24V 300mA MOTOR WITH FAN

1/8" x 1" shaft, 1-1/5" diameter x 2-1/4" long.

94M009 **$2.89 each**

MAGNETIC CONTACTOR

Two poles, 600 VAC @ 30A contacts, 115 VAC coil. NEMA Size 1. GE P/N CR305K002.

98B004 **$19.95 each**

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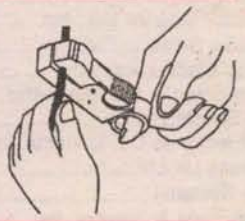
1 Row, 8 characters, with backlit face 1-3/8" x 9/16". Standard 14-pin interface with pinout sheet.

97L001 **$7.95 each**

SONY WALKMAN NiCd BATTERY

6V, 900mAH, 2.75" x 1.75" x 0.75". Part No. BP-MZ1. Sony list price $79.95.

97E026 **Our price $19.95**



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For RG-58, RG-59, RG-62 type cables.

97Z025 **$9.95**

CUTE LITTLE SUCKER

Mini-vac also works as a mini-blower. Runs on four AA batteries (not included). Accessories include dustbag, brush, crevice tool.

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UCN5804. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 timer, parallel port, etc. Build your own robot, anything that requires precision positioning.

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NIPPON PULSE MOTOR

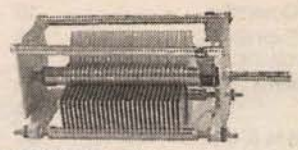
7.5 deg./step, 48 s/rev, 5 V, stepper with brass gear mounted on shaft. NPM P/N PF42-48ES. With spec sheet.

92M010 **$3.95 each**

COMBO PACK!

One 93I002 IC and 92M010 motor (both shown above) with schematics.

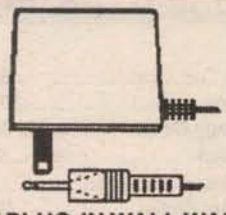
93I003 **$7.95/set**



AIR VARIABLE CAP

30 - 1000 pF.

98P001 **$19.95 each**



DIRECT PLUG-IN WALL WART

Input 120VAC, 60Hz, 16W. Output 12VAC @ 1A. Phone plug.

98E001 **$4.95 each**

"Semiuniversal" RCA 39-BUTTON REMOTE CONTROL

This versatile unit works on several products and brands. Just press desired function button and enter the 3-digit code provided. Requires four AAA batteries. Unused.

97V010 **$9.95 each**

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High-density, impact-absorbing close-cell EVA foam on all exterior walls and 2mm PVC inner belt for extra protection. ABS fabricated handle and bottom has 200 pounds holding strength. Reinforced water-repellent and stain-resistant polyurethane coating. Smooth, self-healing nylon zippers plus anodized strap loop attached to metal plate base. Movable velcro partitions. Ergonomically-designed shoulder strap with nonslip backing and extra padding for user comfort. Easy-to-lock/detach quick hook system. Size 17" x 11" x 3".

15-7056 **$20.00 each**

ATARI 1020 COLOR PRINTER

For all Atari 8-bit computers. (Not PC-compatible!) Package includes: printer, power supply, software, pens, paper and interface cable. These are new units in factory sealed boxes.

94C037 **$14.95 each**

TV AUDIO DEMODULATOR

Unused unit from cable TV box takes channel 3, 4 or 5 signal and demodulates the audio. Comes with documentation and schematics, plus additional schematics to build add-on video demodulator board.

92A028 **$9.95 each**

LOW LIGHT MINI TV CAMERA

I/R LED allows this camera to "see" in the dark. Element: 1/3" monochrome CCD. Lens: Fixed 3.5mm, f:1.8. Field of view: 76° horiz., 55° vert. Automatic electronic iris. Resolution: 360 horiz., 420 vert. Illumination: Ambient light and/or I/R LED supplies additional light in low light conditions. Sensitivity: 0.1 lux @ f1.8. Video output: EIA std 75 Ohm 2:1 interlace. 1.0 Volt P/P composite video. Output connections: 7" video and power leads. Power: 12 VDC ±1V @ 150 mA. Size 2.125" x 2.5" x 1.2". Power supply included.

95V004 **$119.95 each**

ROCKER SWITCH

European-style, DPST, 8A, 250V, mounts in 7/8" x 2" hole. Translucent amber switch.

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Will work on any 4.5cm PGA package. Plastic frame holds heatsink securely to CPU.

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1.5 VDC @ 60 mA pager motor with counterweight. Size approx. 7/8" long by 1/4" diameter.

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Kit 48 **$13.95 each**

NEW PRODUCT SPOTLIGHT

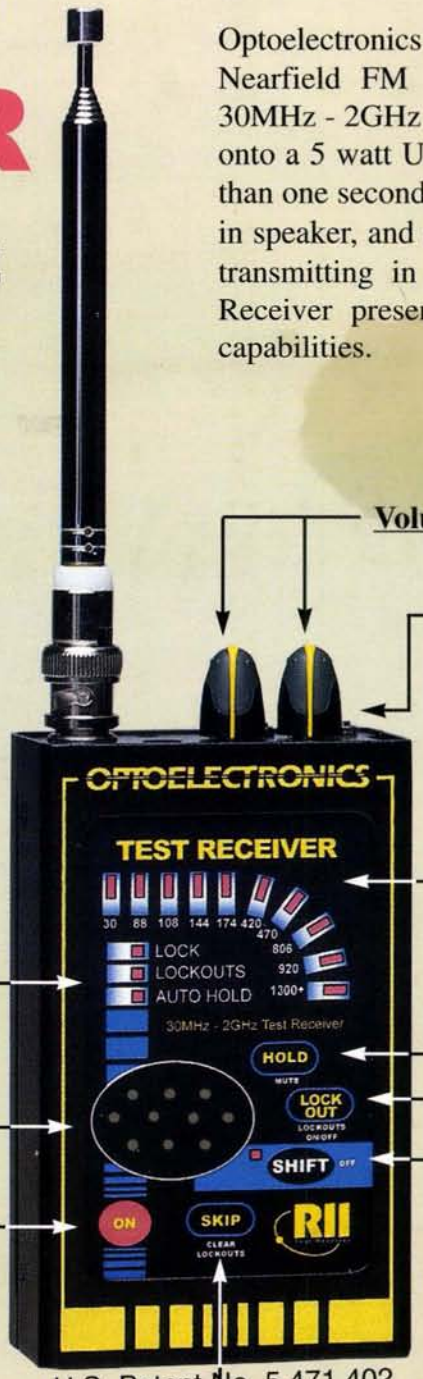
NEW

R11 TEST RECEIVER

30MHz - 2GHz

Handheld Receiver

Optoelectronics is pleased to introduce the all new R11 Nearfield FM Test Receiver. Capable of sweeping 30MHz - 2GHz in less than one second, the R11 can lock onto a 5 watt UHF signal as far away as 500 feet in less than one second, demodulate the signal through its built - in speaker, and display the general band the frequency is transmitting in on its LED indicator. The R11 Test Receiver presents all new performance, features, and capabilities.



Volume & Squelch Control Knobs

Instruction Indicators:
LED's will illuminate which mode the R11 is configured for.

CI-V and Headphone jacks:
CI-V jack allows for connection to the Scout for Reaction Tune. The Headphone jack connection also allows for external speaker.

Frequency Band Indication:
Displays what band the received frequency is transmitting on.

Built - in Speaker :
Instantly demodulate any receiver frequency between 30MHz - 2GHz (Cellular Blocked).

Hold / Mute Button:
The Hold button allows the R11 to stay locked on the received signal.

Power

Lockout / Lockouts on-off:
The R11 allows for 1000 user activated lockouts.

U.S. Patent No. 5,471,402

Shift / Off:
The Shift button controls all of the R11's secondary functions.

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Press the Skip button to continue sweeping. Clear Lockouts will empty the lockout memory.

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Tiny computers run PBASIC programs

BASIC Stamps are small computers programmed in Parallax BASIC (PBASIC), a simple programming language with powerful I/O instructions. The Parallax web site (http://www.parallaxinc.com) provides free software, manuals, and application notes.

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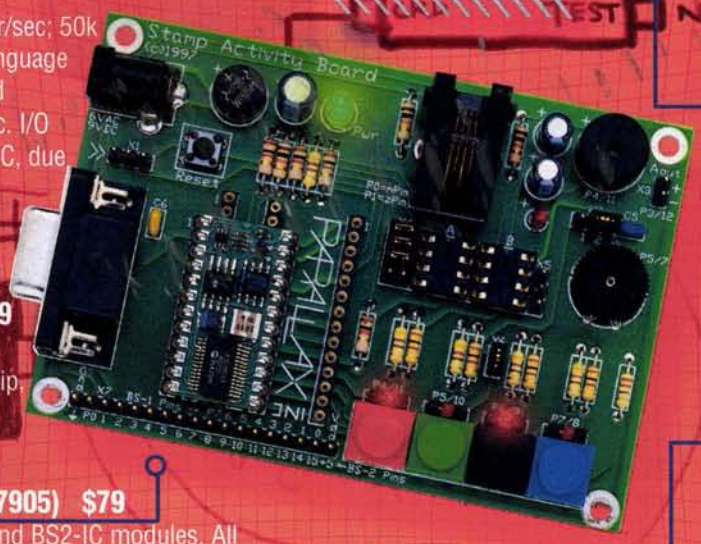
BS1-IC Module (#BS1-IC) $34
8 I/O lines; 80 PBASIC instr max; 2000 instr/sec; 2400 baud serial I/O; 14-pin SIP module. PBASIC language with I/O instructions including BUTTON, HIGH, INPUT, LOW, OUTPUT, POT, PULSIN, PULSOUT, PWM, REVERSE, SERIN, SEROUT, SOUND, and TOGGLE.

BS2-IC Module (#BS2-IC) $49
16 I/O lines; 500 PBASIC instr max; 4000 instr/sec; 50k baud serial I/O; 24-pin DIP module. Similar language as BS1-IC, plus DTMF, FREQOUT, SHIFTIN and SHIFTOUT, XOUT (X-10 powerline control), etc. I/O function have a higher resolution on the BS2-IC, due to its faster clock speed.

Starter Kits

BASIC Stamp I Starter Kit (#27205) $99
BASIC Stamp II Starter Kit (#27203) $149
Starter Kits include BS1-IC or BS2-IC module, carrier board w/prototype area & 9V battery clip, manual, application notes, software,and free tech support.



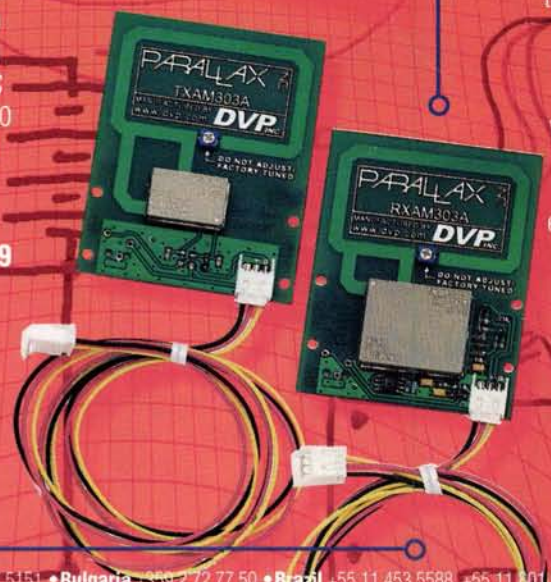
NEW! BASIC Stamp Activity Board (#27905) $79
is used to learn and experiment with BS1-IC and BS2-IC modules. All components and current limit resistors are prewired to BASIC Stamp I/O pins. Board doubles as a "carrier board" with strip header access to I/O pins. Features include LEDs, pushbuttons, piezospeaker, an RC network for changing PWM into a smooth analog output, and an X-10 interface via RJ-11. Sample source code and power supply included!

2-line x 16 character LCD Display (#27910) $54
4-line x 20 character LCD Display (not shown #27919) $109
Use the BASIC Stamp's SEROUT instruction (requires one I/O line, ground and power) to communicate with the Serial LCD display.

Using the PBASIC **HIGH** command and a 470 ohm resistor, BASIC Stamps can **electrify BLUE LEDs!** A stamper necessity! **(#27355) $8**

BASIC Stamp Bug (#27922) $129
(pictured above near Parallax Inc logo)
The BASIC Stamp Bug is a walking robot with 6 legs that is controlled by the BASIC Stamp I interpreter chip. Antennas under the LED eyes attatch to switches which detect obstacles and inform the robot to maneuver around them.

Wireless RF Modules (#27924) $79
Designed by DVP and Parallax, these RF transmitter/receiver modules let you send RS-232 data (0-5 VDC) up to 1,000 feet away. Data transmission is most reliable with check sums and multiple string verification. Transmits at 303.825 MHz, a frequency reserved by the FCC for this type of use. The transmitter and receiver each have a 3-pin cable for connection to BASIC Stamp power, ground, and serial I/O pin. The optional power jack allows for a pluggable power solution if you don't want to use the included 3-pin cable for power.



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